

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

General Certificate of Education Ordinary Level

MARK SCHEME for the June 2004 question papers

4024 MATHEMATICS (Syllabus D)

4024/01	Paper 1, maximum raw mark 80
4024/02	Paper 2, maximum raw mark 100

These mark schemes are published as an aid to teachers and students, to indicate the requirements of the examination. They show the basis on which Examiners were initially instructed to award marks. They do not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

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TYPES OF MARK

Most of the marks (those without prefixes, and 'B' marks) are given for accurate results, drawings or statements.

- **M** marks are given for a correct method.
- **B** marks are given for a correct statement or step.
- **A** marks are given for an accurate answer following a correct method.

ABBREVIATIONS

a.r.t.	Anything rounding to
b.o.d.	Benefit of the doubt has been given to the candidate
c.a.o.	Correct answer only (i.e. no 'follow through')
e.e.o.	Each error or omission
f.t.	Follow through
o.e.	Or equivalent
SC	Special case
s.o.i.	Seen or implied
ww	Without working
www	Without wrong working
*	Indicates that it is necessary to look in the working following a wrong answer



June 2004

GCE ORDINARY LEVEL

MARKING SCHEME

MAXIMUM MARK: 80

SYLLABUS/COMPONENT: 4024/01

**MATHEMATICS (Syllabus D)
Paper 1**



UNIVERSITY of CAMBRIDGE
International Examinations

Page 1	Mark Scheme	Syllabus	Paper
	MATHEMATICS (Syllabus D) – JUNE 2004	4024	1

1	(a) (0).07 cao (b) 8(.00....) (%)	1 1			2	
2	(a) $\frac{2}{3}$ cao (b) $\frac{19k}{21k}$ cao	1 1	Allow decimal in range (0).904 to (0).905		2	
3	(a) 70 cao (b) $1 + 72 + (4 \times 2) = 10$	1 1	(Not 70/1) Both brackets needed. Ignore extra <u>pairs</u> if not wrong		2	
4	(a) $9x^6$ (b) 4	1 1	Accept ± 4 , but not - 4 or $16^{\frac{1}{2}}$	2		
5	(a) 64 (b) 58	1 1			2	
6	(a) 10 (b) $\frac{1}{\text{their (a)}} \begin{pmatrix} 2 & 1 \\ -4 & 3 \end{pmatrix}$ or correct answer	1 1	Accept equivalents Both brackets essential		2	12
7	11 Accept 10.99 (from $\pi = 3.14$)	2	11/2 , $5\frac{1}{2}$ or 5.5 or Figs $\left(\frac{3+3}{360} \times 2 \times \pi \times 105\right)$ seen	C1 M1	2	
8	Condone missing outside brackets and Final answer $\frac{x+7}{(x-3)(x+2)}$ or $\frac{x+7}{x^2-x-6}$	2	use of wrong letter if clear Correct num, but brackets missing in denom or $\frac{2(x+2)-(x-3)}{(x-3)(x+2)}$ oe soi [Condone all missing brackets] [Only available if some working seen]	C1 M1	2	

Page 2	Mark Scheme	Syllabus	Paper
	MATHEMATICS (Syllabus D) – JUNE 2004	4024	1

9 (a)	10	1				
(b)	8	1			2	
10(a)	2.173×10^4 cao	1	Accept . for x Do not accept calculator form	C1	3	
(b)	0.031×10^5 , 217.3×10^2 , 22.6×10^3 , 2.5×10^4 or equivalents	2	Order reversed or Least or greatest identified Condone minor slips if intention clear	C1		
11(a)	2	1		C1	3	
(b)	(c =) 3 (x) (d =) - 5	1 1	One correct or ($f^{-1} : x$) $3x - 5$ seen in working	M1		
12(a)	-8(.0)	1		M1	3	15
(b)	$22\frac{1}{2}$ or 22.5 cao	2	$\frac{6}{t} = \frac{4}{15}$ oe or better seen (not just in ratio form)			
13(a)	Ruled straight line through (0, 0) and (157.5, 40 000)	1	Allow tolerance of $\frac{1}{2}$ small square at points			
(b)	(i) 8500 to 9000	1				
	(ii) $\frac{1}{8}$ or (0).125 cao	1	Condone 1: 8		3	
14(a)	$2\frac{1}{2}$, 2.5 or $\frac{5}{2}$	1	Ignore reference to y coordinate if it is -1	C1	3	
(b)	$y > -1$, $y < x + 3$ and $y + 2x < 4$ oe Accept $\geq$ for $>$ etc throughout	2	All inequalities reversed or Two inequalities correct	C1		
15(a)	(0)68 ⁽⁰⁾	1	Ignore embellishments (eg N 68 E)	C1	3	9
(b)	199 to 201 ⁽⁰⁾	2	Ignore embellishments such as S 199 W Other value in range 196 to 204 or (BAC =) 109 to 111 or (BCA =) 47 to 49 or (ACS =) 19 to 21 or for S 19 to 21 W seen or implied, possibly on diagram	M1		

Page 3	Mark Scheme	Syllabus	Paper
	MATHEMATICS (Syllabus D) – JUNE 2004	4024	1

16(a)	1.515 m oe	1	Unit essential in this case			
(b)	3.96	2	Figs 396 or Figs $\frac{2 \times 0.55 \times 60 \times 60}{1000}$	C1 M1	3	
17	Both 3 and -5	3	$3 \times 4 = x^2 + 3x - x \pm 3$ or better seen and $(x + 5)(x - 3)$ oe seen, condoning missing outside brackets or $\frac{-2 \pm \sqrt{64}}{2}$ obtained	M1 M1	3	
18	40	3	$7^2 = 3^2 + \ell^{(2)}$ seen or implied, eg by $\sqrt{40}$ or $7^2 = 3^2 + 3^2 + \ell^{(2)}$ soi eg by 31 or $\sqrt{31}$ or 6, 7 used correctly	M2 M1 M1	3	
19(a)	30 (%)	2	70 (%) or Figs $\left(\frac{400 - 280}{400} \times 100 \right)$	C1 M1		
(b)	(\$) 20	2	(\$) 520 or Figs $\left(\frac{500 \times 6 \times 8}{100 \times 12} \right)$ seen, if intention clear	C1 M1	4	13
20	Circular arc, centre B, radius 6.5 ± 0.5 cm One line parallel to one coast One arc of circle linking two of these Region clearly identified	1 1 1	Subtending at least 90° at B Parallel by eye, 2 ± 0.5 cm from coasts as long as relevant coast or till it cuts circle Dep on large circular arc and 3 parallel lines, but not lost for wrong measurements Ignore superfluous lines		4	
21(a)	(i) 2 cao (ii) 2.65 to 2.7(0)	1 1	Not 2/1 Ignore any attempt at $x = 0$			
(b)	(i) 0.5 (ii) 3	1 1	Do not accept $x < 2.65$ Condone intrusion of y value of about 6.4 Accept $\frac{1}{2}$		4	8

Page 4	Mark Scheme	Syllabus	Paper
	MATHEMATICS (Syllabus D) – JUNE 2004	4024	1

22(a)	(i) 107(°)	1	Accept on diagram if necessary			
	(ii) 34(°)	1	Accept on diagram if necessary			
(b)	Completely correct solution	2	Any reference to angle at centre, 146 = 2 x 73 or CEA=2xCBA or reference to angles in same segment soi	1 1	4	
23(a)	Condone missing outside brackets, "=0", and use of wrong letter if clear If only "solutions" (even incorrect) in answer space, award marks in working space $5(a - 2)(a + 2)$ oe	2	Incomplete factorisation seen e.g. $5(a^2 - 4)$, $(5a - 10)(a + 2)$ etc	M1		
(b)	(i) - 8	1				
	(ii) $-\frac{k}{2k}$ or - (0).5 cao	1	No follow through. Not $\pm$.		4	8
24	31 (m)	4	30.6 , 30.7, 30.65 or 30.8 or Appropriate diagram or attempt to add 1.8 and 50 tan 30 oe or 50 x 0.577 and Rounding finally to the nearest integer provided some rounding has taken place Accept a reasonable eye level used	C3 M1 M1 M1	4	
25(a)	(i) $2^4 \times 3^2 \times 7^2$ oe	2	Attempted division by same prime at least twice, soi	M1		
	(ii) $(\pm) 84$ cao	1	Not just - 84			
(b)	$(p =) (\pm) 9$, $(q =) (\pm) 4$	1	Any combination of + and - acceptable			
(c)	Any irrational, with no rationals given	1	= 3.142 does not score		5	9

Page 5	Mark Scheme	Syllabus	Paper
	MATHEMATICS (Syllabus D) – JUNE 2004	4024	1

26(a)	(One way) stretch Factor 2	dep	1 1	Ignore reference to invariant line No other transformation to be stated			
(b)	(i) $\begin{pmatrix} 8 \\ 0 \end{pmatrix}$		1	Brackets essential. Not (8 , 0)			
	(ii)(a) A' at A, (4 , 0) C' at (-7 , -2)		1 1	Labels not essential if triangle drawn Labels essential if triangle not drawn			
	(b) 4		1	Accept (good) freehand triangle Indep		6	6

June 2004

GCE ORDINARY LEVEL

MARKING SCHEME

MAXIMUM MARK: 100

SYLLABUS/COMPONENT: 4024/02

**MATHEMATICS (Syllabus D)
Paper 2**



Page 1	Mark Scheme	Syllabus	Paper
	MATHEMATICS (Syllabus D) – JUNE 2004	4024	2

1	(a) (i) (a) 360 (m) (b) 4800 (m)	B1 B1	2	f.t. 5160 – their 360
	(ii) $\frac{6000 \times 3}{10}$ o.e. M1 = 1800 (m)	A1	2	sc1 for 4200 or 600s or 10min seen.
	(iii) $\frac{6000}{7}$ (s) M1 = 14m 17s	A1	2	Allow M1 if 857. ...seen
	(b) (i) 1 : 250000	B1	1	Allow $n = 250000$
	(ii) $2 \times \frac{6}{5}$ (figs) o.e. M1 = 2.4 cm	A1	2	e.g. $\frac{6000 \times 100}{250000}$ Accept 0.024m NB: figs 24 → M1 immediately
			9	
2	(a) $(t - 5)(2v + 1)$ o.e.	B2	2	sc1 for any factor e.g. $2(tv - 5v)$ or if solution given.
	(b) $\frac{h}{k} = 9$ or $\sqrt{h} = 3\sqrt{k}$ M1 $\rightarrow k = \frac{h}{9}$	A1	2	sc1 for any of: $k = \frac{\sqrt{h}}{3}, k = \frac{h}{\sqrt{3}}, k = \frac{h}{3^2}$
	(c) For numerical $\frac{p \pm (or + or -)\sqrt{q}}{r}$			as final answer
	$p = 23$ and $r = 2$	B1		
	$q = 205$ or $\sqrt{q} = 14.3$	B1		
	$x = 18.66$	B1		
	4.34		4	sc1 for 18.6 → 18.7 and 4.3 → 4.35 or for any two answers given to 2 dec. places.
	(d) $\begin{pmatrix} 8 & 4 \\ -6 & 0 \end{pmatrix}$ Accept $a = 8, b = 4$ etc	B2	2	sc1 for 3 elements correct or $3Y = 2 \begin{pmatrix} 12 & 6 \\ -9 & 0 \end{pmatrix}$
			10	
3	(a) (i) 30 (cm ²)	B1	1	
	(ii) $\frac{1}{2} \times 5h + \frac{1}{2} \times 6 \times 4 =$ their 30	M1	2	Possible GRAD answers
	or 9 sin their $\hat{DAB} \rightarrow 7.18 \rightarrow 7.2$	A1		
	(iii) $\tan DAB = \frac{4}{3}$ (or $\sin DAB = \frac{7.2}{9}$ etc.)	M1	2	(a)(iii) 59.0...
	$\rightarrow 53 \rightarrow 53.14$	A1		
	(b) (i) $\cos 51 = \frac{RS}{8}$ o.e. M1 $\rightarrow 5 \rightarrow 5.04$	A1	2	(b)(i) 5.56...
	(ii) $\frac{\sin Q}{8} = \frac{\sin 95}{8.5}$ M1 $\rightarrow \frac{8 \sin 95}{8.5}$ M1 (dep)			(b)(ii) 77.5...
	$\rightarrow 69.6 \rightarrow 70$	A1	3	
	(iii) (a) No: $PQR \neq 90$ or equiv	B1		Ignore superfluous reasoning.
	(b) Mid pt of PR	B1	2	
			12	

Page 2	Mark Scheme	Syllabus	Paper
	MATHEMATICS (Syllabus D) – JUNE 2004	4024	2

4	(a)	$180 - \frac{360}{5} \text{ or } \frac{5-2}{5} \times 180 \text{ o.e.}$	M1			
		$\rightarrow 108^\circ$	A1	2	AG	
			B1			
	(b) (i)	2 lines of symmetry Rot. sym. of order 2	B1	2		
	(ii)	Rhombus	B1		Accept diamond.	
	(iii)	252°	B1			
	(iv)	36°	B1	3		
	(c) (i)	40°	B1			
	(ii)	100°	B1			
	(iii)	120°		3		
				10	f.t. 220 – their 100	f.t.
5	(a)	$n(S \cup F)' \text{ or } n(S' \cap F') \text{ or } n(\text{)} - n(S \cup F)$	B1	1		
	(b)	$y + 80 + 35 - x = 100 \text{ o.e.}$	M1 $\rightarrow x - 15$ A1	2		
	(c) (i)	$x_{\min} = 15$	B1			
	(ii)	$y_{\max} = 20$	B1	2		
				5		
6	(a)	$p = 14 \quad q = 27$	B1	1	<u>both</u>	
	(b)	$k = 2$	B1	1	Accept $3n + 2$	
	(c)	$7n$ -1	B1 B1	2	Accept unsimplified	
	(d)	$R = 41 \quad B = 20$ 9 fences with either $\frac{400}{41}$ or $\frac{200}{20}$	B1 B1	2	NB: 9 fences without working sc1	
				6		

Page 3	Mark Scheme	Syllabus	Paper
	MATHEMATICS (Syllabus D) – JUNE 2004	4024	2

7	(a)	$2 \times 3^2 (56.5..)$ $+ 3^2 (28.2..)$ $= 84.8 - 84.834$	M1 M1 A1	3	
	(b)	$I = \sqrt{16^2 + 4^2} (16.5)$ $\rightarrow \text{CSA} = \pi \times 4 \times 16.5$ $= 207 - 207.5$	M1 M1 A1	3	
	(c) (i)	$\frac{r}{d} = \frac{4}{16} \text{ or } r = \frac{4d}{16}$	B1	1	A.G Alternatively: 4 <u>and</u> 16 with mention of shape or similarity o.e.
	(ii)	$V = \frac{1}{3} \times \pi \times 4^2 \times 16$ $= 267.9 \rightarrow 268.2$	M1 A1	2	
	(iii)	$\frac{1}{3} \pi r^2 d = \frac{268}{2}$ $\frac{1}{3} \pi \frac{d^3}{16} = \frac{268}{2} \text{ o.e.}$ $\rightarrow d = 12.69 - 12.7 \text{ (cm)}$	M1 M1	3	
				12	
8	(a)	Scales All 8 points correctly plotted (within 1 mm) Smooth curve through pts (allow marginally incorrect pts)	S1 P1 C1	3	Lost for st. lines, incomplete, grossly thick.
	(b) (i)	116 – 117	V1		Accept (4.5 , 116)
	(ii)	1.1 – 1.2 <u>and</u> 5.2 to 5.3	V1	2	DiHo Accept (1.1 , 128) , (5.2 , 128)
	(c)	suitable tangent 22 – 40	T1 T1	2	
	(d)	98	K1	1	(2.5 , 98) not accepted
	(e) (i)	$100 = \frac{A}{2} + 2B \rightarrow 200 = A + 4B$	E1		AG
	(ii)	$140 = A + B \text{ or } 100 = \frac{A}{3} + 3B \text{ etc.}$ $A = 120 \quad B = 20$	E1 B2	4	sc1 for attempt to solve $200 = A + 4B$ and 2 nd equation in A and B
				12	

Page 4	Mark Scheme	Syllabus	Paper
	MATHEMATICS (Syllabus D) – JUNE 2004	4024	2

9	(a)	$(BC^2) = 7^2 + 8^2 - (or +) (2).7.8.\cos 120$ (or 60) $BC^2 = 7^2 + 8^2 - 2.7.8 \cos 120 \rightarrow BC = 13$	B1 B1	2	AG	Possible GRAD answers (a) 12.4... (AG) (b) 26.62...
	(b)	Area = $\frac{1.7.8.\sin 120}{2}$ = 24.2 – 24.25 (cm ²)	M1 A1	2		
	(c) (i)	$\frac{1.13.r}{2}$	B1			
	(ii)	$\frac{+1.7.r + 1.8.r}{2}$ M1 = 14r	A1		f.t. 7.5r + their 6.5r	
	(iii)	14r = 24.2 r = 1.728 → 1.733	M1 A1	5	<u>Complete</u> alternative method M1 A1	
	(d)	24.2 – x 1.73 ² = 61 – 61.2 (%)	M1 A1	3 12		
10	(a)	Widths 2, 1, 1, 2, 2, 3 Heights 3½, 8, 6, 5, 1½, 2 All correct (inc. given scales)	M1 M1 A1	3		
	(b)	11 < x ≤ 12	B1	1		
	(c)	fx (496) M1 f (40) M1 = 12.4 indep	A1	3	Allow any clear indication.	
	(d)	26	B1	1	fx = 63 + 84 + 69 + 130 + 45 + 105 = 496 Allow 1 omission or 2 incorr mid pts	
	(e) (i)	0	B1		not $\frac{0}{40}$	
	(ii)	$\frac{6}{40}$	B1		isw	
	(f)	(2x) $\frac{6}{40} \times \frac{34}{39}$ M1 = $\frac{17}{65}$	A1	4 12		

Page 5	Mark Scheme	Syllabus	Paper
	MATHEMATICS (Syllabus D) – JUNE 2004	4024	2

11	(a)	(i)	Number of events	B1		
		(ii)	(a) $\begin{pmatrix} 44 \\ 46 \end{pmatrix}$	B1 + B1		sc1 for (44, 46)
			(b) School scores, totals, no of points o.e.	B1 indep of (a)		
		(iii)	$\begin{pmatrix} 55 \\ 55 \end{pmatrix} \rightarrow \text{Yes, (tie)}$	B1	5	
(b)	(i)		$\overline{PX} = -\frac{1}{3}p + \frac{1}{3}q$ o.e	B1		Accept unsimplified answers
	(ii)		$\overline{OX} = \frac{2}{3}p + \frac{1}{3}q$ o.e	B1		Accept unsimplified answers
	(iii)		$\overline{QY} = p + (k-1)q$ o.e	B1	3	Accept unsimplified answers
	(iv)		$\lambda \overline{OX} = \overline{QY}$ M1 $k = \frac{3}{2}$	A1	2	
	(v)		$\overline{PZ} = \frac{1}{2}q$	B2	2	Accept unsimplified answers
					12	

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

General Certificate of Education Ordinary Level

MARK SCHEME for the June 2005 question paper

4024 MATHEMATICS

4024/02

Paper 2, maximum raw mark 100

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Mark Scheme Notes

Marks are of the following three types:

- M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.
 - A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).
 - B Mark for a correct result or statement independent of method marks.
- When a part of a question has two or more "method" steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly when there are several B marks allocated. The notation DM or DB (or dep*) is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.
 - The symbol $\checkmark$ implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only. A and B marks are not given for fortuitously "correct" answers or results obtained from incorrect working.
 - Note: B2 or A2 means that the candidate can earn 2 or 0.
 B2/1/0 means that the candidate can earn anything from 0 to 2.

The following abbreviations may be used in a mark scheme or used on the scripts:

A.G.	Answer given
b.o.d.	Benefit of doubt
c.a.o	Correct answer only
(in)dep	(In) dependent
Ex.Q.	Extra question
	Follow through
	Further error made
I.S.W.	Ignore subsequent working
M.R.	Misread
o.e.	Or equivalent
O.W.	Omission of essential working
P.A.	Premature approximation
S.C.	Special case
s.o.i	Seen or implied
S.O.S.	See other solution
t.&e.	Trial and error
W.W.	Without working (i.e. answer only seen)
W.W.W.	Without wrong working
(£) or (°)	Condone the omission of the £ or degree sign etc.

JUNE 2005

GCE O LEVEL

MARK SCHEME

MAXIMUM MARK: 100

SYLLABUS/COMPONENT: 4024/02

**MATHEMATICS
PAPER 2**



Page 1	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – JUNE 2005	4024	2

1	(a)	(i)	$9 - 5p$	B1			1	SC1 for any incomplete (correct) factorisation $x = 5$ (or -5) implies M1
		(ii)	$3q^2 - 2r^2$	B1	$+5qr$	B1	2	
	(b)		$2(3t + 1)(3t - 1)$	B2			2	
	(c)	(i)	30	B1			1	
		(ii)	$3x^2 = 75$	M1	$x = \pm 5$	A1	2	
		(iii)	$y - 18 = 3x^2$	M1	$x = \sqrt{\frac{1}{3}}(y - 18)$	A1	2	
							10	
2	(a)	(i)	150 (g)	B1			1	Accept $\frac{9}{11}$ etc. SC1 for 11 : 9
		(ii)	450 : 550 or better	M1	9 : 11	A1	2	
		(iii)	$\frac{'their' 150 + 450}{1250 (figs)}$	M1	48%	A1	2	
	(b)	(i)	(\$) 3.60	B1			1	
		(ii)	Idea that \$6.20 $\equiv$ 80%	M1	\$7.75	A1	2	
							8	
3	(a)	(i)	$t = 69$	B1			1	
		(ii)	$u = 57$	B1			1	
		(iii)	$x = 72$	B1			1	
		(iv)	$y = 15$	B1			1	
	(b)		$3z + 3 \times 105$	M1	$z = 135$	A1	2	N.B. Alt. method using pentagon.
	(c)	(i)	12 (cm)	B1			1	
		(ii)	$\frac{18}{PS} = \frac{14}{18}$ (or $\frac{his 12}{18}$)	M1	15 (cm)	A1	2	
							9	
4	(a)	(i)	$\frac{20}{\cos 55}$	M1	34.8 – 35 (cm)	A1	2	
		(ii)	'their' $34.9 + 20 = 54.8 - 35$ (cm)	B1			1	
		(iii)	$20 \sin 55$	M1	16.3 – 16.4	A1	2	
	(b)		Arc of circle	B1	Centre C or 125° or $r = 20$	B1	2	
	(c)		$\frac{125}{360}$	M1	43.6 – 43.66	A1	2	
							9	

Page 2	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – JUNE 2005	4024	2

5	(a)	(i)	Mode = 0	B1		1	If 0 and 8 mentioned, 0 must clearly be the intended answer	
		(ii)	Median = 1	B1		1		
		(iii)	Mean = $\frac{(0 \times 8) + (1 \times 5) + \dots}{8 + 5 + \dots}$	M1	= 1.6	A1	2	Accept $\frac{8}{5}$, $1\frac{3}{5}$, $1\frac{6}{10}$
	(b)	(i)	$p = \frac{1}{5}$, $q = 1$, $r = 0$ o.e	B2		2	Allow B1 for any 1 correct.	
		(ii)(a)	$\frac{2}{7}$	B1		1		
	(b)	$\frac{4}{21}$	B1		1			
	(c)	$\frac{4}{7}$ or 'their' $\frac{4}{21} \times 3$	B2		2	SC1 for 3 x their $\frac{4}{21}$ or for $\frac{8}{21}$		
							10	
6	(a)		$73 - 37 = 36$	B1		1		
	(b)		Any other 3 pairs	B1		1		
	(c)		Multiples of 9, digits add up to 9	B1		1		
	(d)	(i)	$10x + y$	B1		1		
		(ii)	$10x + y - (10y - x)$	M1	= $9x - 9y$	A1	2	
							6	
7	(a)		$2x^2 = 500$	M1	15.8 – 15.82 (cm)	A1	2	
	(b)		$\frac{1}{3} \times 150 \times h = 500$	M1	10 (cm)	A1	2	
	(c)		$\frac{4}{3}\pi r^3 = 500$	M1	4.9 – 4.925 (cm)	A1	2	
	(d)		Use of R and $R + 1.5$ o.e	M1	or Use of $R + \frac{1.5}{2}$	M1		
			Area of x section = $\pi[(R + 1.5)^2 - R^2]$	A1	Area of x section = $2\pi\left[R + \frac{1.5}{2}\right] \times 1.5$	A1		
		Area of x section = $\frac{500}{6}$	B1					
	(e)		$R = 8 - 8.1$ (cm)	B1			4	
			$\left(\frac{2}{5}\right)^3$	M1	32 (cm ³)	A1	2	
							12	

Page 3	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – JUNE 2005	4024	2

8	(a)	Scales All 10 points correctly plotted (within 1 mm) Smooth curve through points (allow marginally incorrect points)	S1 P1 C1		3	Lost for straight lines, incomplete, grossly thick
	(b) (i)	Negative value 0.32 to 0.45	T1 T1		3	
	(ii)	Rate at which water level is changing or fall of water level per hour o.e	R1			
	(c) (i)	4 (m)	B1			Allow (L1) for any st. line through (0,4) and (6,2) with –ve gradient
	(ii)	Straight line through (0,4) and (6,2)	L2			
	(iii)	Their 2 – their 1.2	M1	75 – 85	A1	
	(iv)	5.7 – 5.9	B1			
					6 12	
9	(a) (i)	$\frac{\sin D}{600} = \frac{\sin 118}{950}$ $\Rightarrow \sin D = \frac{600 \sin 118}{950}$ $\hat{D} = 33.89 - 33.9 \Rightarrow$ $B = 28.1 - 28.11$ (62 – their 33.9)	M1 M1 A1 A1		4	All M and A marks available for any COMPLETE alternative methods. N.B. $\cos 42 = \frac{1040^2 + 950^2 - CD^2}{2 \times 1040 \times 950}$ gets the first M1
	(ii)	$(CD^2 =) 1040^2 + 950^2 - (or+)(2) 1040.950. \cos 42$ $CD^2 = 1040^2 + 950^2 - 2.1040.950 \cos 42$ $= 515000 - 516000$ $CD = 716 - 719 \text{ (m)}$ CN = 1040 sin 42 o.e = 695 – 696 (m)	M1 M1 A1 A1 M1 A1		4 2	
	(b)	Angle of Dep. = $\tan^{-1} \frac{500}{\text{their } 696}$ = 35.6 – 35.75	M1 A1		2 12	

Page 4	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – JUNE 2005	4024	2

10	(a)	$\frac{20}{x}$	B1			
	(b)	$\frac{25}{x+2}$	B1			
	(c)	$\frac{20}{x} - \frac{25}{x+2} = (\pm)1\frac{1}{2}$ $40(x+2) - 50x = 3x(x+2)$ $\Rightarrow 3x^2 + 16x - 80 = 0$	M1 M1 A1		5	N.B. A.G
	(d)	For numerical $p \pm (\text{or } + \text{ or } -)\sqrt{q}$ $p = -16$ and $r = 6$ B1 $q = 1216$ or $\sqrt{q} = 34.8 - 34.9$ B1 $x = 3.145$ B1		-8.479	B1	4
	(e)	Time up $\frac{20}{3.145}$ M1 11 h 13 min or 673 min A1		$\frac{25}{5.145}$ M1		3 12
11	(a) (i)	Reflection	B1	$y = -x$	B1	
	(ii)	$\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$	B1			3
	(b) (i)	$(-1, 3)$	B1			
	(ii)	$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ K is $(2, -1)$	M1 A1			3
	(iii)	Rotation 90° Anticlockwise (or 270° CW)	B1 B1			2
	(iv)	$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$	B2			2
	(c) (i)	1 : 9	B1			
	(ii)	27	B1			2 12
						SC1 for Reflection in x axis Accept $\frac{2}{18}$ etc.

MARK SCHEME for the May/June 2006 question paper

4024 MATHEMATICS

4024/02

Paper 2 maximum raw mark 100

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

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Mark Scheme Notes

Marks are of the following three types:

- M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.
 - C Consolation mark, sometimes awarded for an incorrect answer. In some places it may be earned in the working.
- When a part of a question has two or more "method" steps, the M marks are generally independent unless the scheme specifically says otherwise.
 - FT implies that the candidate has continued correctly after an error.

The following abbreviations may be used in a mark scheme or used on the scripts:

AG	Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
BOD	Benefit of Doubt (allowed when the validity of a solution may not be absolutely clear)
CAO	Correct Answer Only (emphasising that no "follow through" from a previous error is allowed)
CWO	Correct Working Only – often written by a 'fortuitous' answer
FT	Follow through
ISW	Ignore Subsequent Working
MR	Misread
PA	Premature Approximation (resulting in basically correct work that is insufficiently accurate)
SOI	Seen or implied
SOS	See Other Solution (the candidate makes a better attempt at the same question)

Page 1	Mark Scheme	Syllabus	Paper
	GCE O Level – May/June 2006	4024	02

1	(a)	For numerical $\frac{p \pm (or + or -)\sqrt{q}}{r}$ $p = 4$ and $r = 6$ B1 $q = 76$ or $\sqrt{q} = 8.71$ B1 $x = 2.12$ or -0.79 B1 + B1	4	For 'completing the square' $(x - \frac{2}{3})$ seen B1 $2\frac{1}{9}$ oe B1 SC1 for 2.1 to 2.12 AND -0.79 to -0.78
	(b)	$9a^2 + 16b^2 - 24ab$ B2	2	SC1 for $9a^2 + 16b^2$ OR $-24ab$ seen
	(c)	$(4 - y)(3 + 2t)$ B2	2	SC1 for any pair correctly factorised
2	(a)	(i) $2(7 \times 5 + 7 \times 3 + 3 \times 5)$ M1 142 cm^2 A1	2	
		(ii) $x^3 = 7 \times 5 \times 3$ soi M1 4.7 to 4.72 cm A1	2	
	(b)	(i) $\frac{1}{3}\pi 8^2 \times 15$ M1 1005 to 1010 cm^3 A1	2	
		(ii) 17 cm B1	1	
		(iii) $\pi \times 8 \times 17$ M1 427 to 427.3 cm^2 A1	2	
		(iv) 628 to 628.6 f.t. cm^2 B1	1	
				f.t. 201 + their 427
3	(a)	(i) $D\hat{C}B = 62^\circ$ B1	4	f.t. 180 – their 62
		(ii) $D\hat{A}B = 118^\circ$ f.t. B1		
		(iii) $O\hat{D}B = 28^\circ$ B1		
		(iv) $C\hat{O}B = 26^\circ$ B1		
	(b)	(i) $\frac{140}{360}$ soi B1 78.1 to 78.25 cm^2 B1	2	
		(ii) 220° B1 $2 \times \pi \times 8 \times \frac{220}{360}$ M1 46.7 to 46.73 cm A1	3	

Page 2	Mark Scheme	Syllabus	Paper
	GCE O Level – May/June 2006	4024	02

4	(a)	(i)	\$6.05	B1	1		
		(ii)	62.5%	B1	1		
	(b)	(i)	$\cos \hat{HCB} = \frac{60}{80}$ oe	M1	2		
			41.4 ° to 41.41 °	A1			
		(ii)	$\sin 32 = \frac{40}{CD}$	M1	3		
			$CD = \frac{40}{\sin 32}$	M1			
			75.48 to 75.5 m	A1			
		(iii)	$\tan d = \frac{40}{35}$	M1	2		
	$d = 48.8^\circ$ to 49°		A1				
	(c)	(i)	$\frac{4.6}{15}$	M1	3		
		0.31 s	A1				
	(ii)	54 km/h	B1				
5	(a)	6, 10, 14, 18	B1	4			
	(b)	4	B1				
	(c)	(i)	124			B1	
		(ii)	2			B1	
6	(a)	(i)	(a) 8	B1	4	f.t. 27 – their 8	
			(b) 4	B1			
			(c) 21	B1			
			(d) 19 f.t.	B1			
		(ii)	Students who study Maths but not Physics	B1	1	(nor Spanish)	
			or Students who study only Maths	B1			
	(b)	(i)	$\frac{8}{6} = \frac{10}{RC}$ or $\frac{8}{14} = \frac{10}{10 + RC}$ oe	M1	2	e.g. $\left(\frac{10}{10 + \text{their } 7.5}\right)^2$	
			7.5 cm	A1			
		(ii)	$\left(\frac{8}{14}\right)^2$ or $\left(\frac{14}{8}\right)^2$ oe	M1	2		
			98 cm ²	A1			

Page 3	Mark Scheme	Syllabus	Paper
	GCE O Level – May/June 2006	4024	02

7	(a)	$\frac{3}{5} \times 5000$ seen	B1	1	f.t. 15 000 + their 12 500 SC1 for \$33 750	
	(b)	(i)	$\frac{1800}{20000}$ 9%	M1 A1		2
		(ii)	$\frac{2}{5} \times (21800 - 15000)$ \$17 720	M1 A1		2
	(c)	$\frac{5}{3} \times 7500$ \$12 500 \$27 500 f.t.	M1 A1 B1	3		
	(d)	(i)	$\frac{3}{5}(x - 15000)$ oe	B1		
		(ii)	their $\frac{3}{5}(x - 15000) = \frac{x}{2}$ f.t. $x = 90\,000$ $\Rightarrow \$45\,000$	M1 A1 A1		4
8	(a)	2.5	B1	1	lost for straight line, or incomplete	
	(b)	All 10 points plotted correctly f.t. (within 1 mm)	P2			
		8 or 9 points plotted correctly (within 1 mm) (Allow P1) Smooth curve, not grossly thick, thro' all plotted points of which at least 8 are correct	C1	3		
	(c)	(i)	$1.4 < x < 1.5$	X1		
		(ii)	6.4 to 6.5	Y1		2
	(d)	Negative value	G1			
		2.0 to 2.5	G1	2		
	(e)	Line with negative slope thro' (0,12) Also through (6,6)	L1 L1	2		
	(f)	Attempt to simplify $\frac{x^2}{8} + \frac{18}{x} - 5 = 12 - x$ A = 8 AND B = -136	M1 A1	2		Allow M1 for attempt to sub $x = 1.2$ and 7.5 and solve

Page 4	Mark Scheme	Syllabus	Paper
	GCE O Level – May/June 2006	4024	02

9	(a)	(i)	138°	B1	1	All M and A marks available for any COMPLETE alternative method
		(ii)	$\frac{AC}{\sin 48} = \frac{7}{\sin 66}$	M1		
			$AC = \frac{7 \sin 48}{\sin 66}$	M1		
			5.69 to 5.7 km	A1	3	
	(b)	(i)	$\frac{1}{2} \times 7 \times 6.3 \sin 41$	M1		
			14.46 to 14.5 km ²	A1	2	
		(ii)	6.3 sin 41 or $\frac{\text{area}}{3.5}$	M1		
			4.13 to 4.15 km	A1	2	
	(c)		Attempt at Cosine Rule involving $\hat{B}\hat{A}\hat{E}$	M1		
			$\cos A = \frac{9^2 + 7^2 - 5^2}{2 \times 9 \times 7} \left(= \frac{105}{126} \right)$	A1		
			33.5° to 34°	A1		
			(0)56° – 56.5° f.t.	A1	4	f.t. 90 – their $\hat{A}$
10	(a)	(i)	31.8 cm	B1	1	Attempting to take readings at 90 and 30
		(ii)	32.1 – 31.65 cm 0.42 to 0.48 cm	M1 A1	2	
		(iii)	108	B1	1	
	(b)	(i)	9	B1	1	
		(ii)	$(2 \times 7.5) + (4 \times 11) + (6 \times 13) + (3 \times 15) + (1 \times 18)$ ÷ 16 12.5 min	M1 M1 A1	3	
		(iii)	$\frac{7}{30}$ cao	B2	2	
		(iv)	1.6 cm	B2	2	

Page 5	Mark Scheme	Syllabus	Paper
	GCE O Level – May/June 2006	4024	02

11	(a)	(i)	$\begin{pmatrix} -6 & 6 \\ -6 & 8 \end{pmatrix}$	B2	2	SC1 for 3 correct elements
		(ii)	Attempting to find AB or determ $A = 7$ $p = \frac{1}{7}$	M1 A1	2	
		(iii)	$\begin{pmatrix} -2p & 3p \\ -3p & p \end{pmatrix} \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ attempt			
			or $\begin{pmatrix} 1 & -3 \\ 3 & -2 \end{pmatrix} \begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$	M1		
			leading to 4 equations $\frac{1}{7} \begin{pmatrix} 2 & 3 \\ 3 & 1 \end{pmatrix}$	A1	2	
	(b)	(iv)	Reflection in y axis oe	B1 B1		
		(i)	$h = 2$	B1	1	
		(ii)	$\begin{pmatrix} 10 \\ 7 \end{pmatrix}$	B1	1	
		(iii)	-5	B2	2	

MARK SCHEME for the May/June 2007 question paper

4024 MATHEMATICS

4024/02

Paper 2, maximum raw mark 100

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Type of mark

In general:

- (i) 'M' marks are awarded for any correct method applied to the appropriate numbers, even though a numerical error may be involved.
 - a) Once earned they cannot be lost.
 - b) They are earned for a numerical statement which is usually explicit as regards the quantity to be found.
 - c) e.g. the use of a wrong formula, wrong trigonometrical ratio or misapplication of 'Pythagoras' is wrong method.
- (ii) 'A' marks are awarded for a numerically correct stage, for a correct result or for an answer lying within a specified range.
 - a) They are given only if the relevant 'M' mark has been earned.
 - b) They are not given for a correct result following an error in working.
- (iii) 'B' marks are independent of method and are usually awarded for an accurate result or statement.
- (iv) In graph or drawing questions some marks may carry a letter (e.g. G4 for drawing the graph, Q1 for quality, L3 for drawing loci) to make their identification easier.

Abbreviations which may be used in mark schemes or in comments on scripts:

A.G.	Answer given
b.o.d.	Benefit of doubt
c.a.o.	Correct answer only
(in)dep	(In) dependent
Ex.Q.	Extra question
↯	Follow through
✗	Further error made
I.S.W.	Ignore subsequent working
M.R.	Misread
o.e.	Or equivalent
O.W.	Omission of essential working
P.A.	Premature approximation
S.C.	Special case
s.o.i.	Seen or implied
S.O.S.	See other solution
t.&e.	Trial and error
W.W.	Without working (i.e. answer only seen)
W.W.W.	Without wrong working
(£) or (°)	Condone the omission of the £ or degree sign etc.

Page 3	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2007	4024	02

1	(a) (i) (a)	(\$) 9.60	B1		96c or 1.20 B0	9.60 B1
	(b)	(\$) 23.20	B1		12.40 B1	40 B1
	(ii)	$\frac{16-12}{0.8}$ or $\frac{4}{0.8}$ or 5	B1		$\frac{16-1.2}{0.8}$ o.e. B1	
		15	B1	4	28.5 B1	12 B1
	(b) (i)	13(h) 16(m)	B1			
	(ii)	$10\ 00 + \frac{22\ 56 - 10\ 00}{2}$ or $\frac{10\ 00 + 22\ 56}{2}$	M1			
2		16 28	A1	3	Allow 16 h 28 min	
	(c)	'figs 15 × figs 2' OR 'figs 3'	B1			
		4800	B1	2		
	(a)	$\cos \hat{DBE} = \frac{1.5}{1.9}$ o.e.	M1		All M and A marks available for any COMPLETE alternative method.	
		37.86 – 37.9	A1	2		
	(b)	$\tan 68 = \frac{1.5}{AE}$ o.e.	M1		condone $\frac{\sin 22}{AE} = \frac{\sin 68}{1.5}$ for M1	
3		0.6 – 0.61	A1	2		
	(c)	$\frac{1.3}{\sin D} = \frac{1.9}{\sin 76}$ o.e.	M1		dep on first M1	
		$\sin D = \frac{1.3 \sin 76}{1.9}$	M1			
		41.59 – 42	A1	3		
	(a)	$\frac{11}{18a}$	B2	2	SC1 for any equiv. unsimplified form or figs $\frac{11}{18}$ in final answer.	
	(b)	$b^2 - 3b + 8$ (final answer)	B2	2	SC1 for 2 collected terms correct in final answer (without b^3 , b^4 ...) OR: for a correct form without brackets.	
4	(c) (i)	127	B1			
	(ii) (a)	132	B1			
	(b)	$n^3 + 2 + n$ o.e.	B1	3	e.g. accept $n^3 + 3 + n - 1$.	
	(d) (i)	$(y =) x - 38$ o.e.	B1		e.g. accept $x + 22 - 60$.	
	(ii) (a)	$x + 60 = 3(x - 38)$ ✓ 87	B1 B1		✓ $x + 60 = 3 \times$ their $(x - 38)$	
	(b)	196 ✓ <u>strict</u> ✓ on positive x	B1	4	✓ $2 \times$ their $87 + 22$	

Page 4	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2007	4024	02

4	(a)	(i)	60	B1	4	Accept 4 : 9 Not $\frac{9}{4}$ or 2.25 : 1 SC1 for $\frac{44 \times 360}{96}$ or $\frac{44 \times 100}{26 \text{ to } 27}$
		(ii)	9 : 4	B1		
		(iii)	165	B2		
	(b)	(i)	$D\hat{A}C = 33$	B1	4	$\surd$ 180 – their 57
		(ii)	$D\hat{T}C = 24$	B1		
		(iii)	$A\hat{D}C = 57$	B1		
		(iv)	$A\hat{B}C = 123 \surd$	B1		

5	(a)	(i)	Mode = 3	B1	4	If 6 is mentioned 3 must be the clearly intended answer
		(ii)	Median = 4	B1		
		(iii)	$(2 \times 2) + (3 \times 6) + \dots \quad (115)$ 4.6	M1 A1		
	(b)	(i)	$\frac{9}{25}$	B1	2	Accept 36% or 0.36. Accept 100%; Not $\frac{25}{25}$ or $\frac{1}{1}$
		(ii)	1	B1		
	(c)	(i)	$\frac{1}{50}$	B1	3	$\frac{10}{600}$ or better implies M1
		(ii)	$\frac{2}{25} \times \frac{5}{24}$ $\frac{1}{30}$	M1 A1		

6	(a)	Rotational (symmetry) Order 2, centre (3, 0) o.e.	B1 B1	2	–1 if line symmetry stated or implied.
	(b)	(i)	$\overrightarrow{CD} = \begin{pmatrix} 0 \\ 8 \end{pmatrix}$	B1	
		(ii)	$\overrightarrow{OC} = \begin{pmatrix} 6 \\ -4 \end{pmatrix}$	B1	
		(iii)	$\overrightarrow{DO} = \begin{pmatrix} -6 \\ -4 \end{pmatrix}$	B1	
	(c)	Isosceles	B1	1	
	(d)	(3, –2) Shear	B1 B1	2	

Page 5	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2007	4024	02

7	(a) (i)	$20 \times 7 \times 4$ $(3 \times) \frac{1}{2} \times \frac{4}{3} \times \pi \times 2.5^3$ $461.7 \rightarrow 462 \text{ (cm}^3\text{)}$	M1 M1		560 implies M1 32.7... or 98.2... imply M1
	(ii)	216 (cm ³)	A1	3	
	(iii) (a)	$(3 \times) \frac{1}{2} \times 4 \times \pi \times 2.5^2$ $117.7 \rightarrow 118 \text{ (cm}^2\text{)}$	M1 A1	1 2	39.2... implies M1
	(b)	$(20 \times 7 - 3 \times) \pi \times 2.5^2$ $81 \rightarrow 81.2 \text{ (cm}^2\text{)}$	M1 A1		19.6.. or 58.9.. implies M1
	(b) (i)	$V = kx^3 \Rightarrow k = \frac{1}{3} \text{ or } \left(\frac{6}{12}\right)^3 \text{ o.e. seen}$ $71 \rightarrow 72 \text{ (cm}^3\text{)}$	B1 B1		
	(ii)	15.7 → 16.4 (cm)	B2	2	
	(a)	Correct scales 10 correct plots (within 1 mm) Smooth curve (not grossly thick)	S1 P1 C1	3	
	(b)	5.7 to 5.9	T1	1	Must be clearly identified if written on the graph.
	(c) (i)	Negative value } 4 to 6 } final answer	G1 G1		Accept $\frac{a}{b}$ if, a, b integers
	(ii)	Speed or velocity.	G1	3	Accept 'rate of change of distance with time'.
8	(d) (i) (a)	15 (m)	D1		
	(b)	9 (m)	D1		
	(ii)	Straight line –ve slope Through (0, 15) and (6, 6)	L1 L1		(6, 6) within 2 mm
	(iii)	7 – 7.4	B1	5	Must be clearly identified if written on the graph.

Page 6	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2007	4024	02

9	(a)	Attempt at cosine rule $BD^2 = 61^2 + 30^2 - 2 \cdot 30 \cdot 61 \cos 41$ $= 1850 - 1860$ $BD = 43.1$ to 43.12	M1 M1 A1 A1	4	e.g. $61^2 + 30^2 \pm (2) \cdot 30 \cdot 61 \cos 41$ BD can be implied.
	(b)	$\frac{1}{2} \times 61 \times 30 \times \sin 41 (= 600.2...)$	B2		A.G.
	(c)	Same height $\Rightarrow 45 : 30$ (or common vortex)	B1		A.G. Accept use of $\frac{1}{2} ab \sin C$.
	(d)	$900 \rightarrow 901 \text{ (cm}^2\text{)}$	B1	4	
	(e)	$900 = \frac{1}{2} \times 43.1 \times CN \checkmark$ $41.7 - 41.9$	M1 A1	2	$\checkmark$ their $900 = \frac{1}{2}$ their $BD \times CN$
	(f)	$\sin e = \frac{15}{41.8} \checkmark$ $21.0^\circ - 21.1^\circ$	M1 A1	2	$\checkmark \sin e = \frac{15}{\text{their } CN}$ SC1 for final answer $68.9^\circ \rightarrow 69^\circ$
10	(a)	3	B1		
	(b)	2 or -2	B1+B1	3	
	(c) (i)	3	B1		
	(ii)	$-\frac{12}{5}$ o.e.	B1	2	
	(d)	$3x^2 = 5y + 12$ $x = \sqrt{\frac{5y+12}{3}}$ o.e.	M1 A1	2	NB $x^2 = \frac{5}{3}y + 4$ or $\frac{\sqrt{5y+12}}{3}$ score M1
	(e) (i)	$\frac{t-3}{2} = \frac{3t^2-12}{5}$ o.e. $\Rightarrow 5(t-3) = 2(3t^2-12)$ $\Rightarrow$ Given result	B1	1	method must be clear and accurate must reach $6t^2 - 5t - 9 (= 0)$
	(ii)	For numerical $\frac{p+/-\sqrt{q}}{r}$ $p = +5$ and $r = 12$ $q = 241$ of $\sqrt{q} = 15.5...$ (s.o.i.) 1.7 or -0.88	B1 B1+B1	4	For 'completing the square' $\left(t - \frac{5}{12}\right)^2$ B1 , $\frac{241}{144}$, ... B1 SC1 for $1.7 - 1.72$ AND -0.88 to -0.87 or for any 2 ans to 2 sig figs

MARK SCHEME for the May/June 2008 question paper

4024 MATHEMATICS

4024/02

Paper 2, maximum raw mark 100

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

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Type of mark

In general:

- (i) 'M' marks are awarded for any correct method applied to the appropriate numbers, even though a numerical error may be involved.
 - a) Once earned they cannot be lost.
 - b) They are earned for a numerical statement which is usually explicit as regards the quantity to be found.
 - c) e.g. the use of a wrong formula, wrong trigonometrical ratio or misapplication of 'Pythagoras' is wrong method.
- (ii) 'A' marks are awarded for a numerically correct stage, for a correct result or for an answer lying within a specified range.
 - a) They are given only if the relevant 'M' mark has been earned.
 - b) They are not given for a correct result following an error in working.
- (iii) 'B' marks are independent of method and are usually awarded for an accurate result or statement.
- (iv) In graph or drawing questions some marks may carry a letter (e.g. G4 for drawing the graph, Q1 for quality, L3 for drawing loci) to make their identification easier.

Abbreviations which may be used in mark schemes or in comments on scripts:

A.G.	Answer given
b.o.d.	Benefit of doubt
c.a.o.	Correct answer only
(in)dep	(In) dependent
Ex.Q.	Extra question
⌋	Follow through
⌋↘	Further error made
I.S.W.	Ignore subsequent working
M.R.	Misread
o.e.	Or equivalent
O.W.	Omission of essential working
P.A.	Premature approximation
S.C.	Special case
s.o.i.	Seen or implied
S.O.S.	See other solution
t.&e.	Trial and error
W.W.	Without working (i.e. answer only seen)
W.W.W.	Without wrong working
(£) or (°)	Condone the omission of the £ or degree sign etc.

Page 3	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2008	4024	02

1	(a)	$\pi \times (\text{fig } 7)^2 \times 15$ or figs 23 $\pi \times 0.07^2 \times 15$ or $\pi 7^2 \times 1500$ 0.23 to 0.231	M1 A1 A1	[3]	Condone 14/2 for M1 SC1 for 0.92 → 0.924
	(b) (i)	$\cos \hat{T}PA = \frac{15}{23}$ 49.29 to 49.3	M1 A1	[2]	For any <u>complete</u> methods allow appropriate M+ A marks GRAD ANSWERS (i) 54.77...
	(ii)	$\frac{12}{\sin T} = \frac{15}{\sin 37}$ $\sin T = \frac{12 \sin 37}{15} = (28.7 - 29)$ $B\hat{P}T = 114 - 114.22$	M1 M1 M1		(ii) 28.94...→ (iii) 33.97
	(iii)	$\tan A = \frac{15}{23}$ A = 33 to 33.12	M1 A1	[2]	SC1 for 56.8 to 56.9
2	(a) (i)	31.2 to 31.3	B1	[1]	
	(ii)	$\frac{128 - 40}{50}$ o.e. 1.76	M1 A1	[2]	
	(b) (i)	(\$)5.6(0)	B1	[1]	560 (c) ✓
	(ii)	shop B (\$)14.1(2) soi 28(c)	B1 B1	[2]	(\$)0.28 ✓
	(iii)	16	B2	[2]	SC1 for 15
3	(a)	$75 \times 60 \times 24 \times 7 \times 50$ or figs 378 or figs 37 or figs 38 3.78×10^7	M1 A1	[2]	
	(b)	$\frac{18}{2} = \frac{x}{15}$ o.e. 135	M1 A1	[2]	e.g. $\frac{x}{15} = \frac{18+x}{17}$ or $\frac{x}{15} = \frac{2x+18}{32}$

Page 4	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2008	4024	02

(c)	(i)	156	B1		
	(ii)	40	B1		
	(iii)	$220 - \frac{5H}{4}$ o.e. ... isw	B2	[4]	SC1 for $(\pm) \frac{5H}{4}$ soi <u>or</u> any correct expression for -n
4	(a)	Ext. angle = $\frac{360}{8}$ or Sum of int $\angle = (2.8 - 4) \times 90$ o.e. Correct method $\rightarrow 135$	M1 A1	[2]	AG
	(b) (i)	$x = 22\frac{1}{2}$ $y = 45$ $z = 45$ $t = 67\frac{1}{2}$	B1 B1 B1	[4]	
	(ii)	Trapezium	B1	[1]	Any recognizable word.
	(iii)	CE = $\sqrt{100+100}$ or $\frac{10}{\sin/\cos 45}$ $= 14.1 \rightarrow 14.2$	M1 A1	[2]	
	(iv) (a)	$y = z, \hat{BGF} = \hat{EGC}, (\hat{FBG} = \hat{GEC})$	B1		Accept any 2.
	(b)	$1.96 \rightarrow 2.02$	B1	[2]	Or any equivalent integer fraction.
	(a) (i)	24	B1		
	(ii)	8	B1		
5	(iii)	31	B1	[3]	
	(b) (i)	$\frac{5}{36}$	B1		
	(ii)	$\frac{1}{9}$ o.e.	B1		-1 once for un-simplified answers in (b)(i), (ii), (iii)
	(iii)	$\frac{1}{6}$ o.e.	B2	[4]	SC1 for $\frac{1}{12}$

Page 5	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2008	4024	02

(c)	(i)	(215)	B1		Condone 215
	(ii)	(Total) distance (travelled)	B1		Dep. on single element in (c)(i).
	(iii)	43(km/h) $\frac{1}{5}$	B1	[3]	$\frac{1}{5}$ their $215 \div 5$, can be from 3 elements in (c)(i).
6	(a) (i)	64.2	B1		} Accept answers correcting to any of these values
	(ii)	Either 64.5 or 63.6 0.9	M1 A1		
	(iii)	50 cao	B1	[4]	
	(b)	Paul – smaller IQR $\frac{1}{5}$	B1	[1]	Provided answer to (a)(ii) is < 1.5
7	(a) (i)	7500×0.88^2 o.e. 5808 or 5810	M1 A1	[2]	SC1 for 24400 $\rightarrow$ 24440
	(ii)	$6490 \times \frac{100}{88}$ o.e. 7375 or 7370 or 7380	M1 A1	[2]	
	(iii)	100, 88, 77, 68, (60, 53, 46.4) o.e. 6 th day or Sunday	M1 A1	[2]	
	(b) (i)	$\frac{4}{3}\pi \cdot 18^3 \times \frac{1}{2}$ 12200 $\rightarrow$ 12220	M1 A1	[2]	
	(ii)	$2\pi 18^2 + \pi 18^2$ 3050 $\rightarrow$ 3055	M1 A1	[2]	
	(c)	Use of $\left(\frac{h}{12}\right)^3$ or $\left(\frac{1080}{5000}\right)^{\frac{1}{3}}$ 7.1 $\rightarrow$ 7.3	M1 A1	[2]	

Page 6	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2008	4024	02

8	(a)	0.2	B1	[1]	Condone reversed axes. Accept if curve goes through correct point(s) [Ignore $x < -1$] Accept integer fractions. Produce if necessary. SC1 for $\frac{4}{5}2^x = 8 - 2x$ seen
	(b)	Correct scales 8 correct plots (within 1mm) Smooth increasing curve (not grossly thick) through at least 5 of his plots	S1 P1		
			C1	[3]	
	(c)	0	B1	[1]	
	(d)	Clear attempt at tangent (be generous) $4 \rightarrow 5$	T1 G1	[2]	
	(e) (i)	Straight line thro' (08) And thro' (4,0)	L1 L1	[2]	
	(ii)	Approx (2.2, 3.6) [each coord ± 0.1]	B1	[1]	
9	(a) (i)	222° 107°	B1 B1	[2]	e.g. $4.5^2 + 2.8^2 \pm (2) 4.5 + 2.8 \cos 115/65$ HL can be implied by later working Possible GRAD ANSWERS (b) (i) 33.77 5.83 (ii) 6.13 (c) (i) 2.39 or 2.72 6 50 (am)
	(b) (i)	Attempt at cosine rule $HL^2 = 4.5^2 + 2.8^2 - 2 \times 4.5 \times 2.8 \cos 115$ 38.7 to 38.74 6.2 to 6.23	M1 M1 A1 A1	[4]	
	(ii)	$\frac{1}{2} \times 4.5 \times 2.8 \times \sin 115$ 5.7 to 5.71	M1 A1	[2]	
	(c) (i)	$\frac{\text{Area}}{2.25}$ or $2.8 \sin 65$ 2.53 to 2.54	M1 A1	[2]	
	(ii)	$\frac{\text{DistHA}}{\text{Speed}} = \frac{4.5}{3}$ 0650 (h)	M1 A1	[2]	

Page 7	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2008	4024	02

10 (a)	(i)	$8 - x$	B1		
	(ii)	$\frac{1}{2}x(8 - x)$	B1	[2]	Condone omission of brackets.
	(b)	$\frac{1}{2}x(12 - x)$	B1		Condone omission of brackets.
		$12 \times 8 - x(8 - x) - x(12 - x)$ Correct working to $2x^2 - 20x + 96$	M1 A1	[3]	Must see at least one step. AG
	(c)	$2x^2 - 20x + 96 = 60$ & working	B1	[1]	AG
	(d)	For numerical $\frac{p \pm \sqrt{q}}{r}$	B1		– 10 not far enough but can be implied.
		$p = 10$ and $r = 2$			
		$\sqrt{q} = 5.29$ or $q = 28$ 7.65 and 2.35 or 2.36	B1 B1	[3]	
	(e) (i)	$k = 46$	B1		
	(ii)	Area = 46 or his k $x = 5$	B1 B1	[3]	
11 (a)	(i)	Translation $\begin{pmatrix} -6 \\ 3 \end{pmatrix}$	B1 B1	[2]	Accept in words but not $(-6, 3)$ NB: mention of 2 nd transf. loses both marks in each part
	(ii)	Enlargement SF $-\frac{1}{2}$, Centre $(-2, 1)$	B1 B1	[2]	
	(iii)	Rotation 90° AC o.e. Centre $(-1, 0)$	B1 B1	[2]	Accept $+90^\circ$
	(iv)	$\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$	B1	[1]	
	(b) (i) (a)	$p + 2q$ o.e.	B1		–1 once for unsimplified answers.
		(b) $2p - 2q$ o.e.	B1		
		(c) $\frac{1}{3}p + \frac{2}{3}q$ o.e.	B2	[4]	
	(ii)	$\frac{1}{3}$ cao	B1	[1]	SC1 for $\overrightarrow{QS} = \overrightarrow{QR} + \frac{1}{6}\overrightarrow{RT}$ o.e. soi or ans. of $-\frac{1}{3}p - \frac{2}{3}q$ Allow only if correct OR and QS seen

MARK SCHEME for the May/June 2009 question paper
for the guidance of teachers

4024/02

4024 MATHEMATICS

Paper 2, maximum raw mark 100

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	4024	02

1	(a)		$\frac{4a^2 + 9}{6a}$ final answer	B1	1	
	(b)		$5b(b - 2)$ final answer	B1	1	Condone missing final bracket After $0 + 0$ give sc1 for <u>both</u> correct forms seen.
	(c)	(i)	(6, 2)	B1	1	Condone missing brackets
		(ii)	$\sqrt{(\pm 4)^2 + (\pm 10)^2}$ 10.7 to 10.8	M1 A1	2	Accept $2\sqrt{29}$
	(d)		For numerical $\frac{p \pm (or + or -)\sqrt{q}}{r}$ $p = -11$ and $r = 6$ (or 2×3) $q = 205$ or $\sqrt{q} = 14.3$ to 14.32	B1 B1		Completing the square B1 for $\frac{-11}{6}$; B1 for $\sqrt{\frac{205}{36}}$ oe dep. on correct formula s.o.i or <u>used</u>
			0.55 -4.22	B1 B1	4	If final B0 + B0 then sc1 for 0.5 to 0.6 AND -4.2 to -4.22; or for any two answers given to 2 d.p.
					[9]	
2	(a)	(i)	Figs 378/the product of at least 2 of 20, 24, 7 and 60	M1		
			\$31.25	A1	2	Accept \$31.2 $\rightarrow$ \$31.3 \$0.000 031 2 $\rightarrow$ \$0.000 031 3 million;
		(ii)	$\frac{945 - 378}{378} \times 100$ or $\frac{945}{378} \times 100$ 150% cao	M1 A1	2	Accept $\frac{78.125 - 31.25}{31.25} \times 100$
		(iii)	2:5 or $m = 2, n = 5$	B2	2	sc1 for partial simplification seen. 126:315, 54:135, 42:105, 18:45, 14:35, 6:15; or for $\frac{2}{5}$, or 1:2.5, or 5:2 or 2m:5m
	(b)		$\frac{480}{0.6} \times \left(\frac{2}{100} = 16\right)$ 16 cao	M1 A1	2	sc1 for 9.6(euros) or (\$)800 seen.
					[8]	

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	4024	02

3	(a)	(i)	$\tan x = \frac{11}{4}$ 70 to 70.02	M1 A1	2	For any <u>complete</u> methods allow appropriate M and A marks. sc1 for 19.9 to 20
		(ii) (a)	$\sin 28 = \frac{4}{PX}$ or $\frac{PX}{(\sin 90)} = \frac{4}{\sin 28}$ 8.5 to 8.525	M1 A1	2	GRADIAN ANSWERS (i) 77.80 sc1 for 22.2 or 12.2 (ii) (a) 9.39 ... (b) 8.50 (leading to 2.5) or 7.77 ... from Sine Rule (leading to 3.23) ----- -
		(b)	$d = \frac{4}{\tan 28}$, or $PX \cos 28$, or $\frac{4 \sin 62}{\sin 28}$ or $\sqrt{PX^2 - 4^2}$ 7.5 to 7.6 11 – d (= 3.4 to 3.5)	M1 A1 M1	3	
		(b)	$r^3 = \frac{96}{\frac{4}{3}\pi}$ or 22.9 ... 2.84 to 2.841	M1 A1	2 [9]	
4	(a)	(i) (a)	3 (lines of symmetry)	B1	1	AG. Allow if 140° calculated, but not if quoted. The second B mark implies the first.
		(b)	order 3	B1	1	
		(ii) (a)	Use of $(9 - 2) \times 180$ etc.	M1	1	
		(b)	$6x + 3y = 1260$ oe $y = 420 - 2x$ oe isw	B1 B1	2	
	(b)	(c)	Sensible attempt at solving for x or y $x = 136$	M1 A1	2	
		(i)	$\angle FEB = 114^\circ$	B1	1	
		(ii)	$\angle BEA = 42^\circ$	B1	1	
		(iii)	$\angle AGD = 63^\circ$	B1	1 [10]	
5	(a)	(i) (a)	$\frac{1}{50}$, 0.02 cao	B1	1	Accept negatives $\sqrt{4 + \frac{1}{2}}$ (their 5)
		(b)	$\frac{1}{2} \times (8 + 4) \times 200$ oe 1200 m	M1 A1	2	
		(c)	5 m/s	B1	1	
		(ii)	$150u = \frac{1}{2} \times 13 \times 150 (= 975)$ oe $u = 6\frac{1}{2}$	M1 A1	2	

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	4024	02

	(b)	(i)	195 m	B1	1	
		(ii)	24.5 or (25.4 to 25.5) seen $\frac{\text{Distance}}{\text{Time}}$ 7.64 to 7.65	B1 M1 A1	3	N.B. $\frac{190}{25} = 7.6$ scores the M1 only
					[10]	
6	(a)		$p = 11$ $q = 30$ $r = 60$ $s = 6$ all four	B2	2	sc1 for 2 or 3 correct
	(b)		$x = 2n + 1$ oe $y = n(n + 1)$ oe $z = 2n(n + 1)$ oe $\sqrt{2 \times y}$	B1 B1 B1	3	In (b), accept any unsimplified form but -1 , once, if not given explicitly
	(c)		102	B1	1 [6]	
7	(a)	(i)	$\frac{2}{5}$ oe fraction	B1	1	Not 40%; 0.4
		(ii) (a)	$h = 25$	B1	1	
		(b)	$2(50 \times 15 + 60 \times 15) + 50 \times 60$ 6300 cm^2	M1 A1	2	sc1 for 3300 or for 9300 cm^2
	(b)	(i)	$\frac{220}{360} \times 2\pi \times 9 \times 35$ 1208 to 1210	M1 A1	2	
		(ii)	$\frac{220}{360} \times \pi \times 9^2 (= 155.50 \dots)$ $\frac{1}{2} \times 9^2 \times \sin 140 (= 26.03 \dots)$ 181 to 182	M1 M1 A2	4	POSSIBLE GRAD ANSWERS (ii) 188 to 188.3 from $\frac{1}{2} \times 9^2 \times \sin 140 (= 32.7 \dots)$; 177 to 178 from $81 \times \sin 70 \times \sin 20 (= 22.3 \dots)$ (iii) 4.9 from $\cos 70$; 6.2 from $\sin 20$ sc1 for 4.08 ... or for 2.7 ... ----- - If A0, then sc1 for 155 to 156 seen or for 25.9 to 26.1 seen
		(iii)	$d = 9 - 9\cos 70$ $= 5.92$ to 5.93	M1 A1	2 [12]	} } sc1 for 3.07 to 3.08 seen

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
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8	(a)	(i)	$PQ = (x + 2) \text{ m}$			If AB used instead of x , -1 once
		(ii)	$BC = \frac{168}{x}$			
		(iii)	$QR = \frac{168}{x} + 11 \sqrt{BC} + 11$ all 3 (condone $10 + 1$ for 11)	B2	2	sc1 for 1 or 2 correct
		(b)	Area = $(x + 2) \left(\frac{168}{x} + 11 \right) - 168$ or $\sqrt{PQ} \times QR - 168$ as an expression in x correct working to $22 + 11x + \frac{336}{x}$	M1		or $(x + 2) + 10(x + 2) + 2 \times \frac{168}{x}$ oe
				A1	2	Answer given
		(c)	$p = 158 \text{ to } 158 \frac{1}{3}$	B1	1	
		(d)	Correct scales	S1		Condone reversed axes, if labelled
			7 correct plots (ignore $x = 9$) within 1 mm	P1		Accept if curve goes through correct points
			Smooth curve	C1	3	Not grossly thick; no straight lines Ignore curve for $x < 3$ and $x > 8$
	(f)	(i)	$143 \leq \text{answer} < 144$	B1	1	
		(ii)	7.4 to 7.6	B1	1	
					[12]	
9	(a)	(i)	$\frac{AD}{\sin 38} = \frac{17}{\sin 114}$ $AD = 17 \times \frac{\sin 38}{\sin 114}$ 11.4 to 11.5	M1 M1 dep. A1	3	----- GRADIAN ANSWERS (i) 9.7 to 9.8 (ii) 140.9 to 141
		(ii)	$17^2 = 9^2 + 10^2 \pm (2) \times 9 \times 10 \cos x$ } or $\cos x = \pm [(9^2 + 10^2 - 17^2)/(2) \times 9 \times 10]$ } $\cos C = \frac{10^2 + 9^2 - 17^2}{2 \times 9 \times 10} = (-0.6)$	M1 A1		
			126 to 127	A1	3	

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	4024	02

	(b)	(i) (a) $\overrightarrow{OQ} = \mathbf{p} + \mathbf{q}$ (b) $\overrightarrow{RS} = \mathbf{p} - \mathbf{q}$ ✓ (a) – 2q (c) $\overrightarrow{OS} = 2\mathbf{p} + 2\mathbf{q}$ ✓ 2 × (a) (d) $\overrightarrow{OT} = 4\mathbf{p}$ (ii) (O, P and T are) collinear oe $OT = 4OP$ oe	B1 B1 B1 B1 B1 B1	1 1 1 1 2 [12]	In (b) (i), –1, once, for unsimplified answers Marks in (ii) are dep on a correct (i) (d)
10	(a)	Correct scales and axes Correct bases (width + position) Heights (2), 10, 8, 7, 4, 2	S1 B1 H1	3	Condone reversed axes if clearly labelled
	(b)	$7 < t \leq 9$	B1	1	
	(c)	$(4 \times 2) + (10 \times 3.5) + (8 \times 4.5) + (14 \times 6) + (8 \times 8) + (6 \times 10.5)$ (= 290) ÷ 50 5.8	M1 M1 A1	3	8, 35, 36, 84, 64, 63 Condone up to 3 slips Indep of first M
	(d)	(i) 0 (ii) $\frac{14}{25}$ oe 0.56	B1 B1	1 1	Condone $\frac{0}{50}$, none, nil
	(e)	(i) $\frac{54}{175} (= \frac{14}{25} \times \frac{27}{49})$ (0.308 to 0.309) (ii) $\frac{88}{175} (= 2 \times \frac{14}{25} \times \frac{22}{49})$ (0.502 to 0.503)	B1 B2	1 2 [12]	In (e), –1, once, for any answer not in lowest terms, or in decimal form sc1 for $\frac{44}{175}$ (0.251 to 0.252)
11	(a)	(i) $\begin{pmatrix} -3 & 9 \\ -3 & 2x \end{pmatrix}$ (ii) $\mathbf{AB} = \begin{pmatrix} 1 & 0 \\ -1 + \frac{x}{3} & 1 \end{pmatrix}$ or $\mathbf{BA} = \begin{pmatrix} 1 & 3-x \\ 0 & 1 \end{pmatrix}$ or $\mathbf{B}^{-1} = \begin{pmatrix} 0 & 3 \\ -1 & 3 \end{pmatrix}$ oe $x = 3$	B2 B1 B1 dep.	2 2	sc1 for 3 correct elements e.g. $3 \begin{pmatrix} 0 & 1 \\ -\frac{1}{3} & 1 \end{pmatrix}$, (0.33 or better)

Page 7	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	4024	02

	(b)	(i) (a)	SF = -2	B1	1	B1 for each coord. sc1 for $\begin{pmatrix} 1 \\ 2 \end{pmatrix}$
		(b)	Centre is (1, 2)	B2	2	
		(ii)	Shear, x-axis inv., SF = 2	B1 B1	2	
		(iii) (a)	$\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} k \\ 2 \end{pmatrix} = \begin{pmatrix} k+4 \\ 2 \end{pmatrix}$			
			$k = 4$	MA1	1	Mention of a 2 nd transformation loses both marks
		(b)	ET(L) = E((8, 2)) = (-13, 2)	B2	2	
					[12]	sc1 for (-2.5, 2)

MARK SCHEME for the May/June 2010 question paper
for the guidance of teachers

4024 MATHEMATICS (SYLLABUS D)

4024/21

Paper 21, maximum raw mark 100

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2010	4024	21

Section A

Qu	Answers	Mark	Comments
1	(a) $f(7) = 1$ as final answer (b) $\frac{t-2}{5} = t$ $t = -\frac{1}{2}$ (c) Attempt to make x the subject $f^{-1}(x) = 5x + 2$	B1 M1 A1 M1 A1 [5]	Forms an equation in t and attempts to solve SC1 for $(x=)5y + 2$
2	(a) $\frac{66-48}{48} (\times 100)$ 37.5% (b) 130% oe soi $\frac{19.5}{1.3}$ o.e (\$)15 (c) (i) \$88 (ii) \$79.20 \$2.8(0) cao	M1 A1 M1 M1 A1 B1 B1√ft B1 [8]	Accept –2.8
3	(a) Rectangle 13 cm by 8 cm (b) (i) Constructs perpendicular bisector of ZY Arc of circle radius 9 centre X (ii) Labels the correct region (c) (i) P and Q correctly positioned (ii) (a) 42 ± 1 m cao (b) $107^\circ (\pm 2^\circ)$ cao	B1 B1 B1 B1 B1ft B1 B1 [7]	to cross rectangle across rectangle No need to shade – but must be correct Dep on correct P and Q

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4	(a) $\frac{4(2x-1)-3(x+3)}{(x+3)(2x-1)}$	M1	Single fraction. Brackets not essential. Multiplies the first fraction by $(2x-1)$ and the second fraction by $(x+3)$ Multiplies out the numerator with at least 1 pair of terms correct s.o.i. or used SC1 for both 3.0 to 3.1 and -1.7 to -1.74 seen
	$\frac{8x-4-3x-9}{(x+3)(2x-1)}$	M1	
	$\frac{5x-13}{(x+3)(2x-1)}$ oe as final answer	A1	
	(b) Squares both sides of the equation	M1	
	$m = \frac{k^2 - 3n}{2l}$ as final answer	A1	
	(c) For num $\frac{p \pm \sqrt{q}}{r}$		
	$p = 4$ and $r = 6$	B1	
	$q = 208$ or $\sqrt{q} = 14.4...$	B1	
	$x = 3.07,$	B1	
	$x = -1.74$ Final answers	B1 [9]	
5	(a) (i) $p = 0.5, q = 0.2$ $r = 0.3$	B1 B1	Can be implied by $x + 2x + 54 = 78$
	(ii) (a) 0.25	B1	
	(b) 0.5×0.2 seen 0.2	M1 A1	
	(b) (i) 17	B1	
	(ii) $78 - 54$ soi $x = 8$	M1 A1 [8]	
6	(a) Either 136° or 44° correct Other one correct	B2 B1ft	After B0, allow SC1 for $\widehat{ACO} = 22^\circ$, $\widehat{ABC} = 68^\circ$, $\widehat{AEC} = 68^\circ$ or for sum = 180° . Dep
	(b) $\widehat{ABC} = 68^\circ$, $\widehat{BAC} = 44^\circ$ and $\widehat{BCA} = 68^\circ$ Isosceles triangle	B1 B1 [5]	

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7	(a) Mid value used o.e. Sum of (value × frequency) / 80 3.45 (hours)	M1 M1 A1	
	(b) 73, 78	B1	
	(c) Correct scale, points correct and smooth curve	S1 P1 C1	Minus 1 each error P1 for 5 plots which could form ogive C1 reasonable curve
	(d) (i) 3.3 (hours)	B1ft	Read at 40 ft within 0.1
	(ii) Upper quartile and lower quartile used 2.5 (hours)	M1 A1ft[10]	Upper quartile – 2 ft within 0.1

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Section B

Qu	Answers	Mark	Comments
8	(a) $p = -2.6$ stated	B1	Lost for ruled lines, incomplete, very thick
	(b) Scales	S1	
	Five points plotted ft Smooth curve	P1ft C1	
	(c) $x = 2.55$ to 2.65	X1	
	(d) (i) $y = x$	L1	
	(ii) Line drawn and attempt to read at intersect $x = 2.4(0)$ to $2.5(0)$	M1 A1	
	(e) -4	G1	
	(f) (i) Correct line drawn	T1	
	(ii) $(0, 12)$	Y1ft	
	(iii) $y = -4x + 12$	E1ft [12]	
9	(a) (i) $\frac{90}{360} \times \pi \times 16$ +16 28.56 to $28.6(0)$ cm	M1 M1 A1	Correct formula and 90° used Indep. Attempt to add $2 \times$ radius
	(ii) $\frac{90}{360} \times \pi \times 8^2$	M1	Area of cross-section
	[Their $\frac{90}{360} \times \pi \times 8^2$] $\times h$ = 800 soi $h = 15.9(0)$ to 15.92 cm	M1 A1	Indep. Forms equation
	(b) (i) (a) $MN = 2x$	B1	Expect justification and a subtraction
	(b) Area of triangle = $\frac{1}{2}$ their $(2x \times x)$ Area of sector = 16π and Subtraction	M1 A1	
	(ii) $20(16\pi - x^2) = 800$ $x^2 = 10.2...$ to 10.3 $x = 3.2(0)$ to 3.21 cm	M1 A1 A1 [12]	

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10	(a) (i) 140°	B1	Correct method leading to solution
	(ii) $\frac{6 \times 180 - 4 \times 140}{4}$ or $3 \times 180 - 410$ or $180 - 50$ oe 130°	M1 A1	
	(b) (i) $\tan 40^\circ = \frac{CT}{23}$ oe $CT = 19.29$ to $19.3(0)$ cm	M1 A1	
	(ii) 73×39.3 or 50×39.3 $\frac{1}{2} \times 23 \times (\text{their } CT)$ or $\frac{1}{2} (20 + 20 + \text{their } CT) \times 23$ 2640 to 2650 cm^2	M1 A1	Accept $20 +$ their CT for 39.3
	(iii) 10560 to 10600	B1ft	$4 \times$ their (b)(ii)
	(iv) (a) 146 cm 79 cm	B1 B1ft	$40 + 2 \times$ their (b)(i) rounded up
	(b) 930 to 980 cm^2 cao	B1 [12]	
11	(a) (i) $\begin{pmatrix} 6 \\ -5 \end{pmatrix}$	B1	Accept $-\frac{6}{5}$ but not $6, -5$ or $(6, -5)$
	(ii) Enlargement Scale factor $\frac{1}{2}$ Centre $(4, 1)$	M1 A1 A1	A1 and A1 not lost if transformation stated, when SC1 SC1 scored
	(iii) Shear	B1	
	(iv) $y = x (+ c)$ $y = x + 1$	M1 A1	Knowing the equation has gradient 1
	(b) (i) x -coordinate $-q$ y -coordinate $-p$	B1 B1	SC1 for $\begin{pmatrix} -q \\ -p \end{pmatrix}$
	(ii) x -coordinate q y -coordinate $-p$	B1 B1	SC1 for $\begin{pmatrix} q \\ -p \end{pmatrix}$
	(iii) $\mathbf{W} = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$	B1 [12]	

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12	(a) (i) $p - q$	B1	Correct method
	(ii) $\frac{1}{2}(p - q) + \frac{1}{4}p$	M1	
	$\frac{3}{4}p - \frac{1}{2}q$ cao	A1	
	(b) (i) (a) $\frac{1}{2} \times 24 \times 17 \times \sin 55^\circ$	M1	Correct formula and sign and correct algebra soi SC1 for 396 to 397 seen
	167 to 167.5cm²	A1	
	(b) Attempt at cosine rule	M1	
	$XY^2 = 865 - 816 \cos 55$	M1	Value of 6 and correct use of Pythagoras
	19.9 to 19.93 (cm)	A2	
	(ii) (a) $VZ^2 = 15^2 - 6^2$	M1	ft $\frac{1}{3} \times$ their (b)(i)(a) $\times$ their (b)(ii)(a)
	$VZ = 13.7$ to 13.75 cm	A1	
	(b) 766 cm³	B1ft	
	(Accept 762 – 766)	[12]	

MARK SCHEME for the May/June 2010 question paper
for the guidance of teachers

4024 MATHEMATICS (SYLLABUS D)

4024/22

Paper 22, maximum raw mark 100

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Section A

Qu	Answers	Mark	Comments
1	(a) (i) $p = 7, q = 2.9(0)$ $r = 0.25$ or $\frac{1}{4}$ (ii) \$7.75 (b) $0.2 \times 980 (= 196)$ <u>and</u> $24 \times 36 (= 864)$ soi \$80 (c) 3.5%	B1 B1 B1 M1 A1 B3 [8]	Correct method for both parts SC2 for answer of 23.5 or 17.5 SC1 for answer of 117.5 or $763.75 - 650$ soi by 113.75 or 22.75
2	(a) (i) 110 (ii) 10 (b) (i) $x + 2x - 70 + \text{their } 10 = 180$ oe or $x + 2x + \text{their } 110 + 70 + 120 = 540$ oe 80 (ii) 90	B1 B1ft M2 A1 B1ft [6]	120 – their (a)(i) (<u>provided</u> answer > 0) Allow M2 for $2x - y = 70$ and $x + y = 170$ where $y = \widehat{EDA}$ If M0, SC1 for $3x$ soi NB: 80 from wrong working is M0 180 – their (a)(ii) – their (b)(i) Or $2 \times \text{their } \mathbf{(b)(i)} - 70$ (<u>provided</u> answer > 0)
3	(a) Mercury, Mars, Venus, Earth (b) 3000 or 3×10^3 cao (c) $5.5(12) \times 10^{24}$ isw (d) $\frac{4}{3} \pi (6.4 \times 10^3)^3$ 1.09 to $1.1(0) \times 10^{12}$ isw	B1 B1 B1 M1 A1 [5]	
4	(a) $y < 12$ y and $2x$ seen in an equality or an inequality $y > 2x$ oe (b) (i) 16 (ii) $d = 9$ or (3, 9)	B1 M1 A1 B1 B1 [5]	Condone $4 < y < 12$ and $y \leq 12$ SC1 for $y > x$

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5	(a) (i) $\begin{pmatrix} 930 \\ 1235 \end{pmatrix}$ final answer After B0, column matrix with one correct or row matrix with both correct B1	B2	
	(ii) Top value – cost of fruit in week 1 Bottom value – cost of fruit in week 2	B1	
	(iii) \$21.65	B1ft	Sum of their two values divided by 100
	(b) $M = \begin{pmatrix} -6 & 0 \\ 2 & -4 \end{pmatrix}$ oe without fractions	B2	SC1 for either +4M or –4M or + or $-\begin{pmatrix} 24 & 0 \\ -8 & 16 \end{pmatrix}$
	(c) (i) (a) 7	B1	
	(b) {10, 14, 16}	B1	
6	(ii) $\frac{3}{16}$	B2 [10]	SC1 for $(A \cap B) = \{3, 6, 12\}$ Or $n(A \cap B) = 3$
	(a) $m = \frac{1}{8}$ $n = 8$	B1 B1	Accept 0.12 or 0.13 Accept $\frac{32}{4}$ or $\frac{8}{1}$ if correctly plotted
	(b) 5 correct central points	P2	–1 for each wrong plot –1 wrong scale –2 non-uniform scale
	Smooth curve through 5 correct central plots	C1	Lost for ruled or thick lines
	(c) (i) 3.5 – 3.7 ft from $y = 3$	B1	Do not accept embedded answers unless clearly justified on graph
	(ii) 2.5 – 2.7 ft from $y = 1.5$	B1	
	(d) (i) $t = x - 2$	B1	
	(ii) $x = \frac{5}{4}$ or 1.25 final answer	B1 [9]	Follow through their expression provided it is linear

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7	(a) (i) 184 (cm ²)	B1	
	(ii) $\tan \widehat{PSR} = \frac{8}{12}$	M1	
	$\widehat{PSR} = 33.69 \text{ to } 33.7$	A1	
	(b) (i) $\frac{KM}{LM} = \frac{KL}{LN}$ oe	M1	$\frac{KM}{18} = \frac{15}{10}$ oe
	27 (cm)	A1	
	(ii) $KN = 15 \text{ cm}$	B2	After B0, $NM = 12$ seen B1
	(iii) $\frac{16}{65}$ cao	B2 [9]	B1 for unsimplified equivalents or 0.246...

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Section B

Qu	Answers	Mark	Comments
8	(a) $\frac{10}{x}$ (b) $\frac{15}{x+0.5}$ (c) their $\frac{10}{x} + 2 + \text{their } \frac{15}{x+0.5} = 7$ oe $5x(x+0.5) = 10x + 5 + 15x$ $2x^2 - 9x - 2 (= 0)$ (d) For numerical $\frac{p \pm (\text{or } + \text{ or } -)\sqrt{q}}{r}$ $p = 9$ and $r = 4$ $q = 97$ or $\sqrt{q} = 9.848...$ 4.71 -0.21 (e) (i) 5.2(1) (ii) $\frac{10}{\text{their } 4.71}$ and $\frac{15}{\text{their } 4.71 + 0.5}$ $0.75 \leq t \leq 0.8$	B1 B1 B1 M1 A1 B1 B1 B1 B1 B1ft M1 A1 [12]	Correct removal of the denominators x and $x + 0.5$ All correct – Answer given Must see at least 2 steps from previous line SC1 for 4.7 to 4.72 <u>and</u> -0.2 to -0.22 ww...max 2 marks Their $x + 0.5$ (provided $x > 0$) If 2 positive values allow ft on either
9	(a) 305° cao (b) $20^2 + 17^2 \pm (2) \times 20 \times 17 \cos 50^\circ$ $QL^2 = 20^2 + 17^2 - 2 \times 20 \times 17 \cos 50^\circ$ 15.87 – 15.9 (c) (i) $\frac{\sin \widehat{PLQ}}{20} = \frac{\sin 50}{\text{their } 15.9}$ $\sin \widehat{PLQ} = \frac{20 \sin 50}{\text{their } 15.9}$ (= 0.9653) $\widehat{PLQ} = 74.48$ to 74.9 (ii) (0)19.48 to (0)20 (d) (i) 2130 or 9 30pm (ii) $\sin 50 = \frac{x}{17}$ or $\sin Q = \frac{x}{QL}$ $x = 12.9$ to 13.1 (km)	B1 M1 M1 A2 M1 M1 A1ft B1ft B1 M1 A1 [12]	After A0, 251.9, 252 SC1 Dep on first M1 ww 2 marks Their (c)(i) – 55 Not 09 30 (pm)

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10	(a) $n = 4$ 22, 20, 42 $n = 5$ 26, 30, 56	B2	After B0, 4 correct values SC1
	(b) (i) $4n + 6$	B1	Accept $2(2n + 3)$ or $4 \times n + 6$
	(ii) $n^2 + n$	B1	Accept $n(n + 1)$ or $n \times n + n$
	(c) $n^2 + 5n + 6$ $(n + 2)(n + 3)$	M1 A1	Adds their expressions for (b)(i) and (b)(ii) Factorises – answer given NB: Alternative complete methods can score M1A1
	(d) 156	B1	
	(e) (i) $((k + 2)(k + 3) = 306)$ $k^2 + 5k + 6 = 306$ $k^2 + 5k - 300 = 0$	M1 A1	
	(ii) 15 –20	B1 B1	SC1 for –15 and 20
	(iii) 66	B1ft[12]	Their positive integer k substituted into their (b)(i)
11	(a) (i) Correct scales and Correct widths (2, 2, 5, 5, 10) Correct heights (6, 9, 8.4, 5.6, 4)	SW1 H2	3 or 4 correct heights H1
	(ii) 21 or 20	B1	
	(iii) $\frac{5}{7}$ cao	B1	
	(iv) $\frac{132}{870}$, $\frac{22k}{145k}$ or 0.15(0) to 0.152	B2	SC1 for $\frac{132}{900}$, $\frac{11k}{75k}$ or 0.147 or $\frac{12 \times 11}{30 \times 29}$ or $\frac{132}{870}$ seen
	(b) (i) $\frac{7}{60}$ cao	B1	
	(ii) 60	B2	After B0, 35% = 21 seen SC1
	(iii) 8	B2 [12]	SC1 for either 15, 21 and 7 seen or 48° or 13 $\frac{1}{3}$ % seen

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12	(a) (i) 15	P2	After P0, $\sqrt{9^2 + 12^2}$ P1
	(ii) 678 – 679 (cm ²)	S2	After S0, $\pi \times 9 \times$ their 15 + $\pi \times 9^2$ S1
	(iii) 1017 – 1020 (cm ³)	V2	After V0, $\frac{1}{3} \times \pi \times 9^2 \times 12$ V1
	(b) (i) 4 cm	B1	
	(ii) 10 cm	B1	
	(iii) 18.8 – 18.9 (cm)	C2	After C0, $\pi \times 3 \times 2$ C1
	(iv) 979 – 983 (cm ³)	W2	After W0, $\frac{26}{27} \times$ their 1018 or
		[12]	their 1018 – $\frac{1}{3} \pi 3^2 \times$ their 4 W1

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4024 MATHEMATICS (SYLLABUS D)

4024/21

Paper 2, maximum raw mark 100

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Abbreviations

cao	correct answer only
cso	correct solution only
dep	dependent
ft	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
www	without wrong working

SECTION A

Qu	Answers	Mark	Comments
1	(a) 37.35 and A	2	M1 for $315 \times 0.05 + 720 \times 0.03$
	(b) (i) \$0.05	1	
	(ii) Large <u>and</u> 0.0485 seen oe	1	
	(c) 890	3	M1 for $\frac{1134.75}{0.85}$ M1 for their $1335 - (375 + 70)$
2	(a) (7 , 9)	1	
	(b) (i) $y = 2x - 5$	2	M1 for gradient $\frac{(15 + 21)}{(10 + 8)} (= 2)$
	(ii) Yes <u>and</u> $-9 = 2 \times -2 - 5$	1ft	ft correct conclusion from their equation with the working shown
	(c) (i) (a) (-5 , 0)	1	
	(b) $\left(\frac{4p-15}{3}, p \right)$	2	M1 for line through (4 , 9) and (6 , 6)
3	(a) (i) 10.6 – 10.62	2	M1 for $\tan 37 = \frac{8}{QR}$
	(ii) 192	2	M1 for 4^3 seen
	(b) 6.40	2	M1 for $\frac{46.62}{0.45}$
	(c) 18	2	M1 for $(k =) 90$ oe or $\frac{3}{5} \times 30$

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4	(a) $4x + 5y + 4x + 5y = 1020$ leading to $4x + 5y = 510$ $6x + 3y + 6x + 3y + 4x + y + 4x + y$ $= 1360$ leading to $5x + 2y = 340$	1	
		1	
	(b) $x = 40, y = 70$	3	M1 for an attempt to make the coefficients of x or y equal M1 for subtracting the two equations
	(c) 0.56	2ft	M1 for figs 0.8×2.1 and figs 1.6×0.7 After 0, SC1 for answer figs 56 ft $(2 \times \text{their } x \times \text{their } y) / 10\,000$
5	(a) (i) $\begin{pmatrix} -10 & -4 \\ 15 & 7 \end{pmatrix}$	2	B1 for 3 correct terms
	(ii) $\begin{pmatrix} -0.5 & -1 \\ 1.5 & 2 \end{pmatrix}$	2	B1 for $\frac{1}{2} \times (2 \times 2 \text{ matrix})$ or for $\begin{pmatrix} -1 & -2 \\ 3 & 4 \end{pmatrix}$ soi
	(b) (i) 13	2	M1 for $12^2 + 5^2 (= 169)$
	(ii) $\begin{pmatrix} 8 \\ 6 \end{pmatrix}$	1	
	(c) (i) $\begin{pmatrix} -5 \\ 2 \end{pmatrix}$	1	
	(ii) (18 , 9)	1	
	(iii) 22	3ft	M1 for $12 \times (\text{their } 9 - 3)$ M1 for an attempt to subtract area of 3 triangles
	(a) (i) (a) Translation cao $\begin{pmatrix} 1 \\ -5 \end{pmatrix}$	1	
		1	
	(b) Enlargement cao Scale factor 3, Centre (6, 4)	1	
6		1	
	(ii) (a) (-1 , -2)	1	
	(b) (-1 , 0)	1	
	(b) (i) Kite	1	
	(ii) (1 , 3)	1	
	(4 , 2)	1	
			Also (4, -1) is correct for 1

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SECTION B

7	(a) 30.4 to 30.45 (b) $16\cos 25^\circ$ oe (c) (i) 28 www (ii) $\frac{1}{2} \times 28 \times 14.5 (= 203)$ or $348 - \frac{1}{2} 20 \times 16 \sin 115$ (iii) 28.4 to 28.5	4 2 2 1 3ft	M1 for $16^2 + 20^2 \pm (2) \times 16 \times 20 \cos 115^\circ$ M1 for $\sqrt{656 - 640\cos 115}$ A1 for 926.(47....) M1 for $\cos 25 = \frac{x}{16}$ M1 for $\frac{1}{2}(20 + AD) \times 14.5 = 348$ $\frac{1}{2} 30.4 \times 28 \sin 28.5$ M1 for $\frac{1}{2} \times 30.4 \times 28 \times \sin CAD = 203$ M1 for $\sin CAD = \frac{203}{\frac{1}{2} \times 30.4 \times 28}$ ft their <i>AC</i> and their <i>AD</i>
8	(a) (i) $y^2 + 18y + 81 = y^2 + y^2 + 10y + 25$ $y^2 - 8y - 56 = 0$ (ii) 12.5, -4.5 (iii) 21.5 (b) (i) (a) $\hat{QOS} = 90 - x$ and conclusion (b) $\frac{1}{2}(90 + x)$ oe cao (ii) (a) $3 \times \frac{1}{2}(90 - x)$ $= 2 \times \frac{1}{2}(90 + x)$ leading to $180 + 2x$ $= 270 - 3x$ (b) 18	2 3 1ft 1 2 2 1	M1 for $(y + 9)^2 = y^2 + (y + 5)^2$ oe M1 for $y = \frac{8 \pm \sqrt{8^2 + 4 \times 56}}{2}$ soi A1 for one solution or 12.48(5)... <u>and</u> -4.48(5)... ft 9 + their positive <i>y</i> M1 for $\frac{1}{2}(180 - (90 - x))$ M1 for $3 \times \frac{1}{2}(90 - x) = 2 \times$ their <i>OQS</i>
9	(a) (i) Histogram with heights 0.14, 0.56, 0.74, 0.42 and 0.2 widths 100, 50, 50, 50, 100 (ii) 14 – 16 (iii) 200 $m < 250$ (iv) $\frac{7}{20}$ cao	3 1 1 1	B2 for 4 correct columns or B1 for at least 1 correct column After 0, SC2 for “correct” histogram or SC1 for at least 3 “correct” columns (e.g. no vertical or horizontal scale)

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	(b) $(p =) 35$ (c) (i) 1 (ii) $\frac{49k}{750k}$	3 1 2ft	M1 for $\frac{125 \times 14 + 175p + 225 \times 26}{40 + p} = 183$ M1 $183p - 175p = 1750 + 5850 - 7320$ M1 for $\frac{7}{20} \times \frac{14}{75}$ ft their $\frac{7}{20}$ and their 75
10	(a) 32 (b) (i) 1.13 (ii) (a) 56.5 to 56.51 (b) 53 (c) 12.9	2 3 3 2ft 2	M1 for $\frac{200}{6.2}$ B2 for figs 1128.....(or 113) <u>or</u> M1 for fig $0.2 = \pi r^2$ fig 5 M1 for $\pi \times 1.9^2 \times 5$ M1 for their volume – 0.2 M1 for $\frac{3000}{56.5}$ ft their 56.5 with rounding down to an integer M1 for $2 \times \pi \times 1.9 (= 11.9)$
11	(a) (i) 35 (ii) 360 (iii) 7 (b) (i) 10 (ii) (8.00 , 0) to (8.15 , 10) (8.15 , 10) to (8.23 , 22) (8.23 , 22) to (8.47 , 30) (iii) 20 (c) (i) 12.29 cao (ii) 247° (iii) 10.2 to 10.7	1 1 1 1 2ft 2ft 2 1 1	B1 for 2 correct lines ft their 10 and their $10 + 12$ M1 for $\frac{8}{24}(\times 60)$ ft $\frac{18 - \text{their } 10}{24/(60)}$ M1 for $\sin 55 = \frac{MK}{15}$ oe

**MARK SCHEME for the May/June 2011 question paper
for the guidance of teachers**

4024 MATHEMATICS (SYLLABUS D)

4024/22

Paper 2, maximum raw mark 100

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Abbreviations

cao	correct answer only
cso	correct solution only
dep	dependent
ft	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
www	without wrong working

SECTION A

Qu.	Answers	Mark	Comments
1	(a) (i) $\frac{1}{10x}$ cao	1	
	(ii) $\frac{11x-12}{x(x-3)}$ final answer	2	M1 for $\frac{4(x-3)+7x}{x(x-3)}$
	(b) (i) $\frac{1}{4}$ or 0.25	1	
	(ii) $c = 2$ cao $d = 1.5$ oe	2	If 0, B1 for $(f^{-1}(x) = \frac{4x+3}{2})$
	(iii) $g = \frac{1}{2}$ or 0.5	2	M1 for $\frac{2g-3}{4} = -g$
2	(a) (i) $c = \frac{2A}{h} - d$ or $\frac{2A-hd}{h}$ final answer	2	M1 for $c + d = \frac{2A}{h}$ or $\frac{1}{2}hc = A - \frac{1}{2}hd$ oe
	(ii) 3	1	or SC1 for $c = \frac{A}{\frac{1}{2}h} - d$
	(b) (i) 102	2	M1 for 31.5 and 19.5 used
	(ii) 322	3	M2 for $(32.5 \times 20.5) - (25.5 \times 13.5)$ or M1 for (32.5×20.5) or (25.5×13.5)
3	(a) $\frac{1}{3}$	1	
	(b) (i) $\frac{1}{20}$	2	M1 for $\frac{1}{6} \times \frac{3}{5} \times \frac{2}{4}$ seen
	(ii) $\frac{3}{20}$	2	SC1 for $\frac{5}{36}$ M1 for $\left(\frac{3}{6} \times \frac{2}{5} \times \frac{1}{4}\right) + \left(\frac{3}{6} \times \frac{2}{5} \times \frac{2}{4}\right)$ seen

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4	(a) (i) $(u_n) = 3n + 1$ oe (ii) 61 (b) (i) $(v_n) = 17 - 2n$ oe (ii) $(k =) 49$ cao	1 1ft 1 1	ft their u_n with $n = 20$
5	(a) 11 30 cao (b) 39 minutes (c) 8 km (d) 24 km/h (e) park and shopping centre (f) Salim and 9 minutes	1 1 1 1 1 2	B1 for 12 27 or 1 hour 12 minutes seen or 1.2 hours or 72 minutes or for line from (11.15,0) to (12.15,15)
6	(a) (£)1350 (b) (£)225 (c) 108° (d) (£)300 (e) (£)199.80 (f) 9(%) (g) (£)250	1 1ft 1ft 2 2 3 2	ft their (a) 6 ft $\frac{405}{\text{their(a)}} \times 360$ or $\frac{405}{\text{their(b)}} \times 60$ SC1 for 120° or £450 seen. B1 for (£)70.20 or M1 for $(1 - 0.26) \times 270$ oe M2 for figs $\frac{3645}{405}$ or $\frac{11745}{405}$ or $\frac{28755}{405}$ seen SC1 for 81 or 324 seen M1 for 108 % 270 soi
7	(a) (i) 2 (ii) (a) $q - r$ (b) $2p - q - r$ (c) $1 \frac{1}{2} p - r$ (d) $\frac{1}{2} p - q + \frac{1}{2} r$ (b) (i) 45° (ii) 95° (iii) 80°	1 1 1 1 1 1ft 1ft	ft 140 – their (b)(i) ft 125 – their (b)(ii)

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SECTION B

8	(a) (i) $\begin{pmatrix} 3 & 2 \\ 1 & 4 \end{pmatrix}$	2	B1 for 3 correct terms
	(ii) $\begin{pmatrix} -1 & -2 \\ 1.5 & 2.5 \end{pmatrix}$ or $\frac{1}{2} \begin{pmatrix} -2 & -4 \\ 3 & 5 \end{pmatrix}$	2	B1 for $k \begin{pmatrix} -2 & -4 \\ 3 & 5 \end{pmatrix}$ $k = \frac{1}{2}$ or $\frac{1}{2} \times (2 \times 2 \text{ matrix})$
	(b) (i) Reflection $y = 1$	1 1	
	(ii) Enlargement Scale factor $\frac{1}{2}$ Centre $(-5, 0)$	1 1	
	(iii) $(-2, 3)$ $(-4, 5)$ $(-4, 7)$	2	B1 for 2 correct vertices or for $\begin{pmatrix} -2 & -4 & -4 \\ 3 & 5 & 7 \end{pmatrix}$
	(iv) Rotation 90° anticlockwise about $(0, 0)$	1 1	
9	(a) $-5, -6$	1	
	(b) All points plotted correctly <u>and</u> a smooth curve – generous quadratic	2ft	B1 for 5 or more points correct ft from their table
	(c) (i) $x = -2.2$ to -2.35 and 1.65 to 1.85	1	
	(ii) -6.4 $mv < -6.0$	1	
	(iii) 8 to 10	2	M1 for tangent
	(d) (i) $2x^2 + 4x - 3x - 6 = 1 - 2x$ leading to $2x^2 + 3x - 7 = 0$	1	
	(ii) $x = 1.27, -2.77$	4	B3 for one solution or $x = 1.26$ to 1.3 and -2.76 to -2.8 or if in form $\frac{p \pm (or + or -) \sqrt{q}}{r}$ B1 for $p = -3, r = 4$ B1 for $q = 65$ or $\sqrt{q} = 8.06$

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
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10	(a) (i) 74.95 → 75.05 (ii) 336.5 → 337.5 (iii) 44.2 → 44.3 (b) (i) 241 → 241.5 (ii) 12050 – 12100 (iii) 225	1 3 3 2 2ft 1	M1 for $250^2 + 300^2 \pm 2 \times 250 \times 300 \cos 75$ M1 for $\sqrt{152500 - 150000 \cos 75} (= \sqrt{113677})$ M2 for $\sin \theta = \frac{300 \sin 75}{\text{their } 337}$ SC1 for $(\hat{C}SB =) 45.7 \rightarrow 45.8$ seen M1 for $\cos 15 = \frac{DB}{250}$ oe B1 for $\frac{1}{2} \times 200 \times 241 \times \sin 30$ ft 50 × their (b)(i)
11	(a) $\frac{7\pi r^2 H}{9}$ (b) (i) $\sqrt{15^2 + 10^2} = 18(.0)$ (ii) 62.8 → 62.9 or 20π (iii) $\theta = \frac{62.8 \times 360}{36\pi} = 200^\circ$ (iv) 2760 → 2770	3 2 2 2 3	B1 for $\frac{2\pi r^2 H}{3}$ and B1 for $\frac{\pi r^2 H}{9}$ M1 for $15^2 + 10^2$ M1 for $2 \times \pi \times 10$ M1 for $\frac{\theta}{360} \times \pi \times 18 \times 2 = \text{their (ii)}$ M1 for $\frac{200}{360} \times \pi \times 18^2 (= 565.5)$ M1 for $30 \times \text{their (ii)} (= 1884)$
12	(a) 220, 288, 312, 320 (b) (i) 7 correct plots and smooth ogive (ii) (a) 83 → 85 (b) 13.5 → 16.5 (c) 15 to 19% (iii) (a) 76 cao (b) 25% cao (c) More pupils took longer (so) previous test was probably harder	1 3 1ft 2 2 1 1 1	B2 for 5 or 6 correct plots and smooth ogive or B1 for 5 or 6 correct plots ft from their graph M1 for readings at 80 and 240 seen SC1 for 48 → 60 or 81 → 85 seen

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4024 MATHEMATICS (SYLLABUS D)

4024/21

Paper 2, maximum raw mark 100

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isw	ignore subsequent working
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SC	Special Case
www	without wrong working
soi	seen or implied

SECTION A

Qu.	Answers	Mark	Part Marks
1			
(a) (i)	11	1	
(ii) (a)	4, 8, 12, 16	1	
(ii) (b)	x is a multiple of 4	1	
(b)	21	2	M1 for $n(P \cup F)' = 12$
2			
(a)	Option 2 by \$9	2	M1 for $48 \times 2 + 13 \times 6$ or $48 + 13 \times 9$
(b)	\$2700	2	M1 for 2781 is 103%
3			
(a)	$(3x - 8y)(3x + 8y)$	1	
(b)	$x = 2\frac{1}{2}$ or $-5\frac{1}{2}$	3	M1 for $4 \times x \times (x + 3) = 55$ or better M1 for $4x^2 + 12x - 55 (=0)$ After M0 , SC1 for one solution
(c) (i)	$(x - 1)(x + 2) - 15 = 3(x + 2)$ Correct expansion leading to $x^2 - 2x - 23 = 0$	M1 A1	
(ii)	$x = 5.9$ or -3.9	3	If $\frac{p + \sqrt{q}}{r}$ B1 for $p = 2, r = 2$ and B1 for $q = 96$ B2 for one correct solution or $x = 5.8989\dots$ and $-3.8989\dots$ rounded or truncated to 2 or more dp
4			
(a)	1660	3	M1 for $\frac{1}{2} \times 10 \times (50 + 35)$ M1 for 81×10
(b)	24.7	3	M1 for $1206 = \pi r^2 - \pi \times 15^2$ M1 for $r^2 = \frac{1206 + \pi \times 15^2}{\pi}$ (= 608.9)
(c) (i)	$33\frac{1}{3}, 33.3$	1	
(ii)	$\frac{4}{9}$	2	B1 for $\left(\frac{10}{15}\right)^2$ oe seen or $\frac{9}{4}$ seen

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5	(a)	32°	1	
	(b)	$D\hat{C}B$ is alternate to $F\hat{D}C$ $58-32 = 26$	1 1	
	(c) (i)	94°	1	
	(ii)	28°	1ft	ft 122 – <i>their</i> 94
	(iii)	56°	1	
	(iv)	60°	1	
6	(a)	$\frac{1}{2}$	1	
	(b)	$y \geq -1$ $y \leq \frac{1}{2}x$	1 1	If 0 scored, SC1 for both correct, any symbol
	(c)	Correct triangle drawn	2	M1 for two correct vertices or reflection in $y = 2$ or $x = -2$
	(d) (i)	2	1	
	(ii)	(8, -1)	1	
	(iii)	12	2ft	M1 for area of $R = 6$ used
7	(a) (i)	60°	1	
	(ii)	AOB and OBC are equilateral triangles oe	1	
	(b) (i)	$\mathbf{b} - \mathbf{a}$	1	
	(ii)	$2\mathbf{b} - \mathbf{a}$	1ft	ft $\mathbf{b} + \text{their } (\mathbf{b} - \mathbf{a})$ but not $k\mathbf{a}$ or $k\mathbf{b}$
	(iii)	$\frac{3}{4}\mathbf{a} + \frac{1}{4}\mathbf{b}$	2	M1 for $\frac{1}{4}\overrightarrow{AB}$ or $\frac{3}{4}\overrightarrow{BA}$
	(iv)	$\mathbf{b} - \frac{1}{2}\mathbf{a}$	1	
	(v)	$\frac{3}{4}\mathbf{b} - \frac{5}{4}\mathbf{a}$	2	SC1 for $\frac{5}{4}\mathbf{a} - \frac{3}{4}\mathbf{b}$

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SECTION B

8	(a) (i)	307°	1	
	(ii)	<i>B</i> correctly positioned <i>C</i> correctly positioned, with 2 arcs	1 2	M1 for <i>C</i> correctly positioned
	(iii)	074° ± 3°	1	
	(b) (i)	30.8	2	M1 for $\frac{72}{360} \times \pi \times 7^2$
	(ii)	22.8	2	M1 for 8.79(64..) or 8.8 or their arc length + 14
	(iii)	Line parallel to <i>JM</i> 5 cm away Angle bisector of $\hat{JKL}$	1 1	
	(iv)	Correct shading	1	
9	(a)	54.5 www	3	M1 for $6 \times 10 + 15 \times 30 + 29 \times 50 + 18 \times 70 + 9 \times 90 + 3 \times 110$ B1 for ÷ by 80
	(b)	50, 68, 77	1	
	(c)	7 correct points plotted and smooth curve	3	B2 for 7 or 6 correct plots or B1 for 5 or 4 correct plots
	(d) (i)	50 to 55	1	
	(ii)	68 to 72 and 38 to 40 28 to 34	M1 A1	
	(iii)	(16 to 17) / 80 oe	2	M1 for 15 to 17 seen
10	(a)	$x(10 - x)^2$ Correct expansion leading to $x^3 - 20x^2 + 100x$	M1 A1	
	(b) (i)	63, 32	1	
	(ii)	Correct 9 points drawn joined with a smooth curve	3	B2 for 7, 8 or 9 correct points plotted B1 for 5 or 6 correct points plotted
	(c) (i)	147.1 to 150	1	
	(ii)	1.7 – 1.9 5.1 – 5.3	1 1	
	(d)	$y = \frac{\pi x^3}{6}$ seen or implied Attempt at correct curve 5.6 < <i>x</i> < 6	M1 A1 A1	

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11	(a) (i)	18.6 to 18.61	2	M1 for $(AE^2) = 15^2 + 11^2$
	(ii)	11.17 to 11.2	4	M2 for $\cos D = \frac{60.5^2 + 50^2 - 15^2}{2 \times 60.5 \times 50}$ M1 for implicit form A1 for $\cos D = 0.981\dots$
	(b) (i)	50°	1	
	(ii)	11.76 to 11.8	3ft	M2 for $FB = \frac{11 \sin 55}{\text{their} \sin 50}$ M1 for implicit form
	(iii)	51.8 – 51.9 www cao	2	M1 for $\tan \theta = \frac{15}{\text{their} 11.8}$ seen
12	(a) (i)	$\begin{pmatrix} -5 & 6 \\ 0 & -2 \end{pmatrix}$	1	
	(ii)	$\frac{1}{6} \begin{pmatrix} 2 & -6 \\ 2 & -3 \end{pmatrix}$ oe isw	2	M1 for $\frac{1}{6} \times (2 \text{ by } 2 \text{ matrix})$ or $\begin{pmatrix} 2 & -6 \\ 2 & -3 \end{pmatrix}$
	(b) (i)	$m = 1.5$ and $n = 2$	1	
	(ii)	$\begin{pmatrix} 112 \\ 115 \end{pmatrix}$	2	B1 for 1 element correct in a 2 by 1 or both elements seen
	(iii)	3 Difference in training distance of Mark and Luke	1ft 1	ft difference between their 2 values
	(c) (i)	138	1	
	(ii)	44	1	
	(iii)	28	1	
	(iv)	football stadium and cafe	1	

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4024 MATHEMATICS (SYLLABUS D)

4024/22

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soi	seen or implied

SECTION A

Qu	Answers	Mark	Part marks
1 (a)	pentagon	1	After 0 + 0, C1 for $x \dots 5$ oe and $x + y \dots 6$ oe with incorrect (in)equalities for "...".
(b)	$x \leq 5$ oe $x + y \leq 6$ oe	1 1	
(c)	line passing through (5, 0) and (8, 3)	1	
(d)	-1 cao	1	
2 (a)	$x = \frac{3}{5}$ oe	2	M1 for $14x + 2 - 4x - 8 (= 0)$ or better B1 for $p = -24$ and $r = 8$ (or 2×4) B1 for $q = 24^2 - 4 \times 4 \times (-133)$, or 2704 or $\sqrt{q} = 52$ Using factors B2 for $(2h - 7)(2h + 19) (= 0)$ or B1 for $(2h \dots 7)(2h \dots 19) (= 0)$ where ... are not both the correct signs
(b)	$y = \pm 9$	1	
(c) (i)	$h(h + 6) = 33.25$ Rearranging correctly to give $4h^2 + 24h - 133 = 0$	M1 A1	
(ii)	$h = 3.5$ oe and -9.5 oe	3	
(iii)	9.5 cm or <i>their</i> (positive h) + 6	1 ft	

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3	(a)	36 minutes cao	1	M1 for 85% = 4.42 oe
	(b)	5 km/h cao	1	
	(c)	\$5.2(0)	2	
	(d)	Horizontal line from (1800, 4) to (2000, 4)	1	
		Line from (2000, 4) to (2030, 2.5) or ft from (<i>their</i> 2000, 4) to ((<i>their</i> 2000) + 30, 2.5)	1 ft	
	(e)	20 30 or (<i>their</i> 2000) + 30	1 ft	
4	(a)	279° to 283°	1	M1 for correctly positioned <i>Y</i> with one correct construction arc, or with no construction arcs or M1 for <i>Y</i> above <i>WX</i> and two correct construction arcs
	(b)	<i>Y</i> correctly positioned with two correct construction arcs	2	
	(c)	<i>Z</i> on a bearing of 072° from <i>W</i> <i>Z</i> is due North of <i>X</i> 27 to 29 km	1 1 1	
5	(a) (i)	25, 9	1	M1 for 7.75 to 7.85 and 6.55 to 6.65 seen B1 for 22 seen or C1 for $\frac{38}{60}$ oe M1 for $3.5 \times 4 + 4.5 \times 15 + 5.5 \times 20 + 6.5 \times 13 + 7.5 \times 5 + 8.5 \times 3$ i.e. $14 + 67.5 + 110 + 84.5 + 37.5 + 25.5$ (= 339) M1 for $\div 60$ (or $4 + \dots$) B1 for 65%, or for 21 seen
	(ii)	7.15 to 7.25	1	
	(iii)	1.1 to 1.3	2	
	(iv)	$\frac{22}{60}$ oe, or 0.36 to 0.37, or 36 to 37%	2	
	(b) (i)	5.65 cm	3	
	(ii)	35%	2	
6	(a) (i)	4, 8, 10, 14	1	B1 for Venn Diagram and 17 in $(G \cup S)'$
	(ii)	1	1	
	(iii)	3 out of {2, 5, 7, 11, 13}	1	
	(b)	Correct shading	1	
	(c)	16	2	

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7	(a) (i)	$b - a$	1	
	(ii)	$\frac{1}{2}(b + c)$	1	
	(iii)	$\frac{1}{4}b + \frac{1}{2}c$ or <i>their</i> (aii) $-\frac{1}{4}b$	2 ft	B1 for one correct term or for $-\frac{1}{4}b - \frac{1}{2}c$
	(b) (i)	$\frac{2}{5}b - \frac{2}{5}a$	1	
	(ii)	$2 : 3$ oe	1	
	(iii)	$\frac{3}{5}a - \frac{7}{20}b - c$	2	B1 for one correct term, or for $c + \frac{7}{20}b - \frac{3}{5}a$

SECTION B

8	(a) (i)	128 to 128.4	3	M2 for $\cos B = \frac{20^2 + 2^2 - 21.3^2}{2 \times 20 \times 2}$ or M1 for $21.3^2 = 20^2 + 2^2 - 2 \times 20 \times 2 \times \cos B$
	(ii)	14.3 to 14.5	3	M2 for $\sin((\text{their}(ai) - 90) = \frac{x}{20}$ oe (12.4)
	(b) (i)	29°	1	
	(ii)	9.6 to 9.7	3	M2 for $CE = \frac{8.6 \times \sin 33}{\sin(\text{their}(bi))}$ or M1 for $\frac{CE}{\sin 33} = \frac{8.6}{\sin(\text{their}(bi))}$ oe
	(iii)	11.6 to 11.7	2	C1 for 78.3 to 78.4 or B1 for 11.6 to 11.7 or 78.3 to 78.4 seen in working

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9	(a) (i)	$\begin{pmatrix} -5 & 0 \\ 1 & 2 \end{pmatrix}$	1	
	(ii)	$\begin{pmatrix} 0 & -\frac{1}{3} \\ \frac{1}{2} & \frac{1}{6} \end{pmatrix}$ or $\frac{1}{6}\begin{pmatrix} 0 & -2 \\ 3 & 1 \end{pmatrix}$ seen	2	M1 for $\begin{pmatrix} 0 & -2 \\ 3 & 1 \end{pmatrix}$ seen, or for attempting to multiply $\frac{1}{6}$ by a 2×2 matrix
	(b) (i)	$\begin{pmatrix} 974 \\ 328 \end{pmatrix}$	2	B1 for one correct value, or for (974 328)
	(ii)	Mention of cost and (both carpet and underlay)	1	
	(c) (i)	<i>F</i> correctly positioned	2	M1 for 2 correct vertices plotted or C1 for correct reflection in $y = x$
	(ii)	<i>G</i> correctly positioned	2	M1 for 2 correct vertices plotted or for 3 correct coordinates calculated
	(iii) (a)	4; or -4	1	
	(iii) (b)	$m = 1, n = \text{their(c)(iii)(a)}$	1 ft strict	
10	(a) (i)	686 to 687 cm ²	4	M1 for using $\frac{300}{360}$ oe M1 for using $\pi \times 15^2$ M1 for $\frac{1}{2} \times 15^2 \times \sin 60$ oe (= 97.4278 ...)
	(ii)	93.5 to 93.6 cm	2	M1 for $\frac{300}{360} \times 2 \times \pi \times 15$ (= 78.5398...)
	(b)	12.4 cao	2	B1 for $\frac{1}{2}(15 + 25)h = 248$ oe
	(c) (i)	3	1	
	(ii)	37.36 to 37.4 cm ²	3	M1 for 248 + <i>their(a)(i)</i> M1 for division by 5 ² soi (indep)

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11	(a) (i)	56°	1	B1 for $\hat{ACD} = 28^\circ$ seen B1 for seeing $\hat{DAC} = 42^\circ$; or $\hat{ABC} = 70^\circ$; or $\hat{ABO} = 8^\circ$ If 0 + 0, then C1 for both 32° and 116°
	(ii)	34° or 90 – <i>their(a)(i)</i>	1 ft	
	(iii)	62° or (180 – <i>their(a)(i)</i>)/2	1 ft	
	(iv)	42°	2	
	(v)	110°	2	
	(b) (i) (a)	32° alternate (to $\hat{PQT}$)	1	
	(i) (b)	116° $\hat{SPQ}$ and $\hat{PQR}$ are allied, interior, adjacent	1	
	(ii)	Full line parallel to PS , 4 cm away Full arc, centre R , radius 5 cm	1 1	
	(iii)	Correct region shaded	1 ft	
12	(a)	Convincing reason. e.g. The height of the cuboid would then be –2 cm	1	 B2 for 6 or 7 correct (ft) plots or B1 for 4 or 5 correct (ft) plots B1 for 4.5 to 4.7 seen B1 for $(y=) 27x$ seen or implied M1 for attempt at drawing correct line
	(b)	$x^2(8-x)$ and $\frac{4}{3} \times 3 \times (\frac{x}{2})^3$ Correct expansion and simplification to $8x^2 - \frac{x^3}{2}$	M1 A1	
	(c) (i)	58.5	1	
	(ii)	7 correct plots and a smooth curve	3	
	(iii)	3.3 to 3.5	2	
	(d)	$4.7 \leq x < 5$ (dep on M1)	3	

MARK SCHEME for the May/June 2013 series

4024 MATHEMATICS (SYLLABUS D)

4024/21

Paper 2, maximum raw mark 100

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Abbreviations

cao	correct answer only
cso	correct solution only
dep	dependent
ft	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
www	without wrong working
soi	seen or implied

SECTION A

Qu.	Answers	Mark	Part Marks
1	(a) $x = 3$	2	M1 for $\pm 5x = \pm 15 =$
	(b) $x = 4, y = -1$	3	B2 for one correct value www
	(c) (i) $-1, 0, 1$	1	
	(ii) $y > -2$ final answer	2	B1 for -2 seen
2	(a) 24	2	B1 for 15 seen
	(b) (i) (a) $180 - q$ cao	1	
	(i) (b) $p - q$ cao	1	
	(ii) (a) 8 cm	1	
	(ii) (b) 4.9 cm	1	
3	(a) (i) 10, 12	1	
	(ii) $2m$ oe	1	
	(b) (i) 25, 36	1	
	(ii) n^2	1	
	(iii) 18	1	
	(c) (i) $t^2 + 2t$ oe	1	
	(ii) 675	1	

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4	(a) (i)	$\frac{10}{11}, \frac{1}{11}, \frac{9}{10}, \frac{1}{10}, \frac{10}{10}, \frac{0}{10}$ oe correctly placed	2	B1 for 3 correct values correctly placed M1 for 3 ×
	(ii) (a)	$\frac{6}{11}$ oe	1	
	(ii) (b)	$\frac{9}{22}$	2	
	(b) (i)	1	1	
	(ii)	2	1	
5	(a) (i)	€ 216	1	B2 for Loss \$43.40 or M1 for two of 87.50, 48.60 and \$27.20 and M1 for attempt at adding any three prices and then subtracting 120
	(ii)	(\$1 = €) 0.68	1	
	(b) (i)	Profit \$43.3(0)	3	
	(ii)	36 to 36.1%	1 ft	
6	(a) (i)	68.7°	2	M1 for $\tan A = \frac{18}{7}$ M1 for $\tan 55 = \frac{18}{DE}$ A1 for $DE = 12.6$ to 12.61 cm M1 for $\frac{1}{2}(9 + 7 + \text{their } 12.6) \times 18$ or for a complete alternative method
	(ii)	257 to 257.5	4	
	(b)	26°	2	
7	(a)	0.01 m/s cao	2	M1 for 200/19.94 or 100/9.98 B1 B1 B2 for 1 correct answer Or for 58 – 59 AND –61 – –62 B1 for $\frac{-3 \pm \sqrt{14409}}{2}$ C1 for –58.5 AND 61.5 M1 for 120/their positive 58.5
	(b) (i)	$\frac{120}{x}$ or $\frac{120}{x+3}$ $\frac{120}{x} - \frac{120}{x+3} = \frac{6}{60}$ oe Correct eqn with denominator removed	3	
	(ii)	$x = 58.5$ or -61.5	3	
	(iii)	123 – 123.1 minutes	2	

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SECTION B

8	(a) (i)	-5.5 or $-5\frac{1}{2}$	1	
	(ii)	$f^{-1}(x) = \frac{2x+3}{4}$	2	C1 for $\frac{2x-3}{4}$ or $\frac{2y+3}{4}$ oe
	(iii)	$g = 0.5$ or $\frac{1}{2}$	2	M1 for $\frac{8g-3}{2} = g$
	(b) (i)	Enlargement Scale factor -3 , Centre A	2	B1 B1
	(ii)	2.2 to 2.24 or $\sqrt{5}$	1	
	(iii)	$\begin{pmatrix} 0 \\ -7 \end{pmatrix}$	2	B1 for 0 B1 for -7
	(iv)	$\begin{pmatrix} 10 \\ 1 \end{pmatrix}$	2	M1 for use of $\overrightarrow{DF} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$ or $\overrightarrow{AF} = \begin{pmatrix} 1 \\ -2 \end{pmatrix}$
9	(a) (i)	$h = 29.8$ to 29.85	2	M1 for $\pi \times 4^2 \times h (=1500)$
	(ii)	100	1	
	(b)	$x = 2.5$	2	M1 for $\frac{1}{2} \times 12x \times 5x$ or better for cross section
	(c) (i)	$(2y-3)(2y+11)$	1	
	(ii)	$y = 1.5$ or -5.5	1	
	(iii)	67.5 cm^2	1 ft	
	(iv)	495 cm^2	3	B1 $2 \times \text{their (iii)}$ B1 $240 \times \text{their 1.5}$
	(d)	$\frac{9}{25} \text{ cao}$	1	

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10	(a) (i)	$\frac{2}{3}, \frac{2}{3}$ oe	1	
	(ii)	8 points correctly plotted and one set of 5 joined with a curve	2 ft	B1 for at least 6 correct plots
	(iii)	1.7 to 1.8 AND –1.7 to –1.8	1 ft	M1 for tangent to curve at –1.5 soi After M0, SC1 for 3 to 4
	(iv)	–2.5 to –5 (dep on M1)	2	M1 for $x + y = 2$ drawn
	(v)	–1.3 to –1.4 (dep on M1)	2 ft	One mark for each
	(b) (i)	$a = 3, b = 405$ (cao)	2	
	(ii)	(0, 5) cao	1	
	(iii)	20	1 ft	
11	(a) (i)	510 – 520 m	1	
	(ii)	C positioned 7 cm from A and 6 cm from B with both construction arcs drawn	2	B1 for c positioned 7 cm from A and/or 6 cm from B
	(iii)	$146^\circ \pm 2$	1 ft	
	(iv)	D positioned $10.3 \text{ cm} \pm 0.8$ from A and $\hat{DAC} = 34^\circ \pm 2^\circ$	2	B1 for $DAC = 34 (\pm 2^\circ)$
	(b) (i)	164 to 164.11° www	4	B3 for $QPR = 110$ to 110.11 Or B2 for $\frac{-2750}{80000}$ or -0.343 to 0.344 Or B1 for $(\cos P =) \frac{160^2 + 250^2 - 340^2}{(2 \times) 160 \times 250}$ And M1 for their $P + 54^\circ$
	(ii)	18780 – 18800	2ft	M1 for $\frac{1}{2} \times 250 \times 160 \times \sin 110.1$

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12 (a)	(i)	14.8 kg www	3	M1 for $15 \times 3 + 14 \times 8 + 20 \times 12 + 24 \times 15 + 31 \times 17 + 24 \times 20 + 12 \times 26 (= 2076)$ M1 for dividing by 140 (indep)
	(ii)	Correct histogram	3	M2 for 5 correct bars or M1 for 3 correct bars or all correct heights seen
	(iii)	$\frac{11}{35}$ oe	2	M1 for $15 + 14 + 15 (= 44)$ used
(b)	(i)	9	1	
	(ii)	35%	1	
	(iii)	96°	2	M1 for $(15 + 2) \div 64 (\times 360)$

MARK SCHEME for the May/June 2013 series

4024 MATHEMATICS (SYLLABUS D)

4024/22

Paper 2, maximum raw mark 100

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SC	Special Case
www	without wrong working
soi	seen or implied

Qu.	Answers	Mark	Part Marks
1	(a) (i) \$720.7 – \$721.1	2	M1 for $25200 \div 72 (=350)$ or $\frac{2.06}{72}$ or $\frac{72}{2.06}$
	(ii) \$1.45	1	
	(b) (i) \$8272	2	M1 for $8000 \times \frac{3.4}{100}$ or better
	(ii) 8560 - 8562	1ft	
	(iii) Lydia by \$1.52, final answer, cao	2	or C1 for Simone's 8560 seen or C1 for Simone by \$8.28 final answer
2	(a) 25, 21, 45	2	B1 for 2 correct
	(b) n^2	1	
	(c) 32	2	B1 for $(T=)$ 1024 seen
	(d) $\frac{3}{2}n(n+1)$ oe	1	
	(e) 360	1ft	
	(f) $\frac{1}{2}(n+1)(n+2)$ oe	2	or C1 for $\frac{1}{2}(n-1)(n-2)$ oe
3	(a) $x = -4$ cao	2	M1 $\pm 2x =$ or $\pm 8 =$
	(b) (i) $y \leq 4.25$ oe final answer	2	C1 for 4.25 oe seen
	(ii) 3,4	1	
	(c) $x = 1.5, y = -3$	3	B2 for 1 correct value www Or B1 for pair of values satisfying either eqn
4	(a) 7	2	M1 for $(AF + 16) \times 6 = 138$ or equiv seen
	(b) (i) $EG = 5.75$	2	C1 for 11.5 seen or for 5.7 or 5.8 seen
	(ii) $23k : 41k$ where k is an integer	2	B1 for $(their\ 5.75) : (16 - their\ 5.75)$ C1 for $41k : 23k$

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5	(a)	No and 799.5 cm (or 7.995 m)	2	M1 for 180.5 and 15.5 seen
	(b) (i)	\$27	2	M1 for $130\% \equiv 35.10$ soi
	(ii)	\$1210 – 1211	3	M1 for $50.70 \times 4 + 35.10 \times 5$ (378.30) M1 for <i>their</i> 378.30×2.2 (=832.26) Or their 202.80×2.2
6	(a)	35°	1	
	(b)	286.7 to 287	2	M1 for $\sin$ their $35 = \frac{x}{500}$ or better
	(c)	(0) 31 to (0)31.2	3	M1 for $\tan \theta = \frac{335}{500}$ or $\frac{500}{335}$ B1 for $\hat{SPQ} = 33.8 - 34$
7	(a) (i)	Bar height 1.4 between 100 – 120	1	
	(ii)	$p = 48$ $q = 42$	2	B1 for $p = 48$ or B1 for $q = 42$
	(iii)	$\frac{57}{200}$ or 0.285 or 28.5%	1	
	(b) (i)	$40 < y \leq 60$	1	
	(ii)	39.9	3	M1 for $34 \times 10 + 57 \times 30 + 85 \times 50 + 24 \times 70$ (= 7980) i.e. $340 + 1710 + 4250 + 1680$ M1 for dividing by 200 (indep)

SECTION B

8	(a)	150 m	1	
	(b)	C due east of B ($\pm 2^\circ$) and C 12 cm (± 2 mm) from A	2	B1 for due E of B , B1 for 12 cm from A
	(c)	994.9 to 995 m	2	M1 for $1800^2 - 1500^2$ (= 990000) Or $12^2 - 10^2$ (= 44)
	(d)	$\frac{1800}{x}$ or $\frac{1500}{x+1}$ $\frac{1800}{x} - \frac{1500}{x+1} = 60$ oe Correct eqn with both denominators removed	3	B1 B1

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(e)	$x = 7.83, -3.83$	3	B2 for one correct answer Or for $7.8 - 7.85$ AND $-3.8 - -3.85$ OR B1 for $\frac{4 \pm \sqrt{136}}{2}$ or better. Or C1 for -7.83 AND 3.83
(f)	$229 - 230$ s	1ft	
9 (a) (i)	$\begin{pmatrix} 5 \\ 2 \end{pmatrix}$	1	
(ii)	$\sqrt{45}$ or 6.7 to 6.71	2	B1 for $\begin{pmatrix} -3 \\ 6 \end{pmatrix}$ or $\begin{pmatrix} 3 \\ -6 \end{pmatrix}$ seen. Must be in vector form.
(iii) (a)	Enlargement Scale Factor 3 Centre B	2	B1 for Enl, B1 for SF3 and Cent B oe
(b) (i)	$\begin{pmatrix} 7.5 \\ 3 \end{pmatrix}$	2ft	B1 for 7.5 B1 for 3.
(ii)	$f(-4) = -2$	1	
(iii)	$g = 11$	2	M1 for $\frac{3g+2}{5} = 7$
(iv)	$f^{-1}(x) = \frac{5x-2}{3}$ oe	2	C1 for $\frac{5x+2}{3}$ or $\frac{5y-2}{3}$ oe
10 (a) (i)	$\frac{n}{24}$		B1
(ii)	$\frac{24-n}{24}$ oe	2	B1
(iii) (a)	$\frac{n(25-n)}{25 \times 24}$ oe final answer	1	
(b)	$p = 4$	2	B1 for their (a) = $\frac{1}{p}$
(iv)	$n = 15$ or 10	2	M1 for $(n-15)(n-10)$ or $\frac{25 \pm \sqrt{25}}{2}$ seen
(v)	$\frac{3}{20}$ oe	2	C1 for $\frac{7}{20}$ oe

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	(b) (i)	300	1	
	(ii)	$\frac{1}{12}$	1	
	(iii)	25	1	
11	(a) (i)	– 8.5	1	
	(ii)	8 points correctly plotted and joined with a smooth curve on correct axes	3	B1 for correct scale (condone rev axes) B1 for 6 or 7 given table points correctly plotted on their axes B1 for smooth curve through all 8 points on their consistent axes
	(iii)	2.5 – 6.5 (dep on tangent soi)	2	M1 for tangent at $x = 1.5$ soi
	(iv)	– 0.85 to – 0.95	2	M1 for $y = 1$ soi
	(b) (i)	$p = 1.2$ $q = 0.5$	2	B1 for $p = 1.2$, B1 for $q = 0.5$ ft
	(ii)	$-\frac{4}{5}$ oe	2	M1 for $\frac{-2}{3 - theirq}$ oe
12	(a)	$r = 22$ cao	3	B1 for 70000 soi M1 for $\pi \times r^2 \times \text{figs46}$ (only term)
	(b) (i)	18(.0) to 18.03 cm ²	2	M1 for $\frac{1}{2} \times 4 \times 11 \times \sin 125$
	(ii)	360 to 360.6 cm ³	1ft	
	(iii)	$x = 13.69$ to 13.7	4	M1 for $4^2 + 11^2 \pm (2) \times 4 \times 11 \times \cos 125$ M1 for $x^2 = 4^2 + 11^2 - 2 \times 4 \times 11 \times \cos 125$ or better A1 for 187.4 – 187.5
	(iv)	609.8 to 610.1 cm ²	2	M1 for at least 4 correct areas

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4024/21

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Question	Answers	Mark	Part marks
1 (a)	$\frac{8-x}{(x-4)^2}$	2	M1 for $\frac{x-2(x-4)}{(x-4)^2}$ or better
(b)	$x = 2.5$ o.e., $y = -3$	3	B2 for one correct with supporting working Or B1 for pair of values satisfying one equation
(c)	$x = 6$ or -1	3	M1 for $x^2 - 5x - 6 = 0$ M1 for $(x-6)(x+1) = 0$ Or M2 for $\frac{5 \pm \sqrt{49}}{2}$ Or M1 for 5 and 2 correct or $\sqrt{49}$
(d)	$\frac{y+3}{2y+5}$ final answer	3	M1 for $(y+3)(y-3)$ seen M1 for $(2y+5)(y-3)$ seen
2 (a) (i)	0 or none	1	All correct
(ii)	7, 8, 11, 13, 14	1	
(iii)	$\frac{3}{11}$ or 0.27 or better	1	
(iv)	5	1	
(b) (i)	3	1	
(ii)	11	1	
(iii)	18	1	

Page 3	Mark Scheme	Syllabus	Paper
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3	(a) (i)	37.5[%]	2	M1 for $5.5 \div (240 \div 60)$ soi by 1.375 Or B1 for either 150 seen and 90 seen
	(ii)	73.5[0]	2	M1 for $45 \times 5.5 + (60 - 45) \times 5.5 \times 0.8$ oe Or B1 for 247.5 seen or for 66 seen
	(iii)	208.7[0]	2	M1 for $240 \div 1.15$ oe
	(iv)	2837.5[0]	2	M1 for $2500 \times 0.045 \times 3$ oe soi by 337.5
	(b) (i)	160	1	
	(ii)	1.21875 to 1.22	2	M1 for $0.78 \div 0.64$
4	(a) (i)	24°	1	
	(ii)	18°	1	
	(iii)	42°	1	
	(iv)	108°	1	
	(b) (i)	14.56 to 14.6	2	M1 for $\cos 72 = \frac{4.5}{AD}$
	(ii)	13.3 to 13.304...	2	M1 for $\frac{DE}{\sin 66} = \frac{4.5}{\sin 18}$ Or for ' <i>their (b)(i)</i> ' $\times \cos$ (' <i>their (a)(i)</i> ')
5	(a) (i)	$n + 6, n + 7$	1	
	(ii)	$(n + 1)(n + 6) - n(n + 7)$ $= n^2 + 7n + 6 - n^2 - 7n = 6$	2	M1 for $(n + 1)(n + 6) - n(n + 7)$ or reversed Or B1 for $n^2 + 7n + 6$
	(b) (i)	$5n + 50$ or $5(n + 10)$	2	M1 for $[n], n + 9, n + 10, n + 11, n + 20$ seen
	(ii)	56, 65, 66, 67, 76 completed in cross	2	M1 for $n = 56$ Or for 66 in centre of cross

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6	(a) (i)	60.28 to 60.35	2	M1 for $\pi \times 1.6^2 \times 7.5$
	(ii)	(a) length 9.6, width 6.4	1	Condone reversed
		(b) 98.7 to 99.2	2	M1 for 'their $9.6 \times 6.4 \times 7.5 - 6 \times$ 'their 60.3' Or B1 for 460.8, or 361.68 to 362.1
	(b) (i)	224.5[375]	2	M1 for 17.75 and 12.65 seen
	(ii)	No, frame could measure 17.5 cm by 12.5 cm	1	Accept statement involving lower bound of either length or width
7	(a)	-3.5, 5.5	2	B1 for each
	(b)	7 correct plots joined with smooth curve	2	P1 for at least 5 correct plots
	(c)	$x = -2.7$ to -2.6 , 0.3 to 0.4 , 2.2 to 2.3	2	FT <i>their</i> curve B1 for 2 correct solutions
	(d)	Tangent drawn at $x = -2$ 2 to 3	M1 A1	On <i>their</i> curve
	(e) (i)	$y = 5 - 4x$ oe	2	M1 for $y = -4x + k$ or $y = mx + 5$ or $-4x + 5$
	(ii)	$C = 1, D = -4$	2	M1 for $\frac{x^3}{2} - 3x + 1 = 5 - 4x$ FT

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8	(a)	32.25 or 32.75	3	M1 for $(4 \times 5 + 12 \times 15 + 16 \times 25 + 23 \times 35 + 20 \times 45 + 5 \times 55) [= 2580]$ M1 for $\div 80$
	(b) (i)	[4], 16, 32, 55, 75, 80	1	
	(ii)	6 correct plots joined with smooth curve using correct axes	3	B2 for 6 correct plots Or B1 for 4 correct plots
	(iii)	(a) 33 to 35	1	
		(b) 18 to 20	2	B1 for 41 to 43 or 21.5 to 23.5
	(c)	$\frac{1}{30}$	2	M1 for $\frac{5}{25} \times \frac{4}{24}$
9	(a)	248.6 to 249	3	M1 for $130^2 + 164^2 + \text{or} - [2] \times 130 \times 164 \times \cos 115$ And M1 for $AC^2 = 130^2 + 164^2 - 2 \times 130 \times 164 \times \cos 115$
	(b)	9660 or 9661.2(...)	2	M1 for $\frac{1}{2} \times 130 \times 164 \times \sin 115$
	(c)	7	2	M1 for $\frac{\text{their } 9660 \times 3.25}{5000}$ or 6(.2) or 6.3
	(d)	43.49 to 43.5	2	M1 for $130 \tan 18.5$
	(e)	148.6 to 149	3	B1 for 65° or 25° seen M1 for $164 \times \sin '65'$ or $164 \times \cos '25'$ soi

Page 6	Mark Scheme	Syllabus	Paper
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10	(a) (i)	3.16 to 3.163 or $\sqrt{10}$	1	
	(ii)	vector $\begin{pmatrix} 3 \\ -3 \end{pmatrix}$ drawn	2	B1 for two correct movement without arrow Or one correct movement with arrow
	(iii)	$a = 2, b = 3$	2	B1 for each Or SC1 $a = -2$ and $b = -3$
	(b) (i)	Enlargement Scale factor -2 Centre (3, 1)	B1 B1 B1	B0 for question if second transformation mentioned
	(ii)	(a) (5, 4), (7, 4), (5, 6) (b) Stretch Factor 2 x -axis invariant	2 B1 B1	B1 for 2 correct
11	(a)	$\frac{100}{x}$	1	
	(b)	$x^2 - 77x + 200 = 0$ derived www	4	B1 for $\frac{80}{x-5}$ seen M1 for $\frac{100}{x} + \frac{80}{x-5} = 2.5$ oe M1 for $100(x-5) + 80x = 2.5x(x-5)$
	(c)	74.31 and 2.69 final answer	4	B3 for one correct root seen or for 74 to 74.31 and 2.69 to 2.7 If in the form $\frac{p \pm (or + or -) \sqrt{q}}{r}$ B1 for $p = 77$ and $r = 2$ And B1 for $q = 5129$ or $\sqrt{q} = 71.6...$
	(d)	74.31, because 2.69 would give negative speed for second part	1	
	(e)	11	2	M1 for $\frac{100}{74.31} - \frac{80}{74.31-5}$ or 0.191 [hours]

MARK SCHEME for the May/June 2014 series

4024 MATHEMATICS (SYLLABUS D)

4024/22

Paper 2, maximum raw mark 100

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Page 2	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2014	4024	22

Question	Answers	Mark	Part marks
1 (a)	138 to 140	1	
(b)	D marked at intersection of correct arcs	2	B1 for a correctly positioned D with one correct construction arc or no correct arcs Or, provided D to the west of AB B1 for D on one correct arc or radii 5 cm and 6 cm reversed with arcs Or, provided D to the east of AB B1 for D on intersection of two correct construction arcs
(c)	103°	1	Tolerance $\pm 2^\circ$
(d) (i)	P and Q marked at intersection of perpendicular bisector and circle	3	B1 for perpendicular bisector of AC minimum 3 cm long B1 for arcs radius 4.5 cm centre B , minimum 3 cm long cumulatively B1 for P and Q at correct positions
(ii)	249°	1	Tolerance $\pm 2^\circ$
2 (a) (i)	97	1	
(ii)	$(c = \pm)\sqrt{\frac{4f + d}{6}}$	2	M1 for $4f = 6c^2 - d$ or better
(b)	$x \geq 2$ cao	2	B1 for final answer $\{+ \text{ or } -\} x * \{+ \text{ or } -\} 2$, where $*$ can be wrong inequality or equals
(c)	$(3 + 5x)(3 - 5x)$ oe	1	Must be integers
(d)	$(8p - 3q)(x - 2y)$ oe seen isw	2	M1 for $x(8p - 3q)$ oe or $-2y(8p - 3q)$ oe Or $8p(x - 2y)$ oe or $-3q(x - 2y)$ oe

Page 3	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2014	4024	22

Question	Answers	Mark	Part marks
(e)	1.12 and –2.32 final answer	4	B3 for one correct solution or $x = 1.1$ to 1.121 and –2.321 to –2.3 If in the form $\frac{p \pm (or + or -)\sqrt{q}}{r}$ B1 for $p = -6$ and $r = 10$ And B1 for $q = 296$ or $\sqrt{q} = 17.2...$
3	(a) (i) 533.9(0) to 534	2	M1 for $32 \times 5.20 + 0.15 \times 2450$
	(ii) 1760	3	M1 for $409.6 - 28 \times 5.20 [= 264]$ M1 for ‘ <i>their</i> 264’ $\div 0.15$
	(b) (i) 3.75	2	SC1 for an answer of 28.75, 28.7, 28.8, 15, 3.7, 3.8 or 0.0375
	(ii) 402.5[0] or 403 or 402	2	M1 for $\frac{920}{(4 + 5 + 7)} \times 7$
4	(a) (i) $\frac{1}{3}$	1	After 0+0 allow B1 for 2/6 and 4/6 Or 0.33 and 0.66 or better
	(ii) $\frac{2}{3}$	1	
	(b) (i) 25 numbers completed correctly	1	
	(ii) (a) $\frac{18}{30}$ oe isw	1	After 0+0+0 for (b) , If all 36 used B1 for 18/36 and 10/36 If 35 used, B1 for 18/35 and 9/35
	(b) $\frac{8}{30}$ oe isw	1	
5	(a) 78.1 to 78.13	2	M1 for $\cos 35 = \frac{64}{AB}$ or better
	(b) 127.9 to 128	3	M1 for $64^2 + 80^2 + or - (2) \times 64 \times 80 \cos 125$ M1 for $AD^2 = 64^2 + 80^2 - 2 \times 64 \times 80 \cos 125$
	(c) 24.1 to 24.2°	3	M1 for $\frac{\sin ADC}{64} = \frac{\sin 125}{their 128}$ oe M1 for $\sin ADC = \frac{64 \times \sin 125}{their 128}$
	(d) 2900	2	M1 for $0.5 \times (80 + 65) \times 40$

Page 4	Mark Scheme	Syllabus	Paper
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Question	Answers	Mark	Part marks
6 (a)	$23 - 6n$ cao	2	B1 for $-6n$ soi
(b) (i)	4, 10, 18, 28	2	B1 for 3 correct terms seen
(ii)	3 and 24	4	M1 for $\frac{n^2 + 3n}{5n - 12} = 6$ or better M1 for $n^2 - 27n + 72 = 0$ B1 for either 3 or 24
7 (a) (i)	9600 cao	2	M1 for $\frac{360}{60} \times 1600$ oe
(ii)	$\frac{11}{60}$ cao	1	
(iii)	1440 cao	2	M1 for $\frac{(144 - 90)}{360} \times their 9600$ oe
(b) (i)	40.1	3	M1 for $12 \times 17.5 + 36 \times 25 + 45 \times 35 + 33 \times 50 + 24 \times 70$ M1 for division by <i>their</i> $(12 + 36 + \dots + 24)$
(ii)	Correct histogram	3	B1 for 5 bars correct width and position B1 for at least 3 correct heights $k \times (2.4, 3.6, 4.5, 1.65, 1.2)$ B1 for 5 correct heights
(iii)	38 or 39 or 40 or 41	1	
8 (a) (i)	$\begin{pmatrix} 4 \\ -5 \end{pmatrix}$	1	
(ii)	6.4(0) to 6.41 or $\sqrt{41}$ cao	1	
(iii)	$y = -1.25x + 7$ oe	2	B1 for gradient = -1.25 or y -intercept = $+7$ soi in a final equation
(iv)	(12, -8)	2	B1 for one value correct
(b) (i) (a)	$\mathbf{b} - \mathbf{a}$	1	
(b) (b)	$3\mathbf{a}$ cao	1	
(c)	$4(\mathbf{b} - \mathbf{a})$	2	B1 for correct unsimplified $\overrightarrow{CD}$ or for $3(\mathbf{b} - \mathbf{a})$
(ii) (a)	1 : 4	1	
(b)	1 : 15	1	

Page 5	Mark Scheme	Syllabus	Paper
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Question	Answers	Mark	Part marks
9 (a)	$\sqrt{15^2 + 6^2} = 16.15(5\dots)$	1	Must be shown to at least 2 d.p.
(b)	417 to 419	3	M1 for $\pi \times 6 \times 16.2$ soi by 305.4 M1 for $\pi \times 6^2$ soi by 113.1
(c)	565 to 566	2	M1 for $\frac{1}{3} \times \pi \times 6^2 \times 15$ or better
(d)	316 to 317	2FT	FT <i>their</i> (c) $\times 0.56$ evaluated B1 for figs 316(...) or 317(...) or <i>their</i> (c) $\times$ figs 56 evaluated
(e) (i)	18.89 to 18.9	2	M1 for $\sqrt[3]{2}$ or 1.25... seen oe
(ii)	662 to 665	2	M1 for $\left(\sqrt[3]{2}\right)^2$ or 1.58... seen oe
10 (a)	$[L =] \quad 2\left(x + \frac{50}{x}\right) \text{ or } 2x + 2\frac{50}{x}$ or $x + x + \frac{50}{x} + \frac{50}{x}$	2	B1 for $\frac{50}{x}$ seen
(b)	41.5 to 41.6, 45	2	B1 for one correct
(c)	Correct smooth curve through the eight given points correctly plotted on correctly scaled axes	3	$\pm$ half a small square B2 for seven or eight of the given points correctly plotted on <i>their</i> axes or B1 for six of the given points correctly plotted on <i>their</i> axes
(d)	$2.8 \text{ to } 3.2 < x < 16.8 \text{ to } 17.2$	B1 B1	M1 for attempt to read off two x values at $y = 40$
(e) (i)	$27.5 < \text{answer} < 28.5$	1	
(ii)	7, 7 cao	1	
(f)	10, 10 cao	1	

Page 6	Mark Scheme	Syllabus	Paper
	GCE O LEVEL – May/June 2014	4024	22

Question	Answers	Mark	Part marks
11 (a) (i)	$EC = BE$ or $AC = FE$ and $\angle AEC = \angle FBE$ or $\angle ECA = \angle BEF$ Two correct reasons for their choices	B1 B1	Statements and reasons: $EC = BE$; radii $AC = FE$; diameters $\angle AEC = \angle FBE [= 90^\circ]$; angle in semicircle $\angle ECA = \angle BEF [= 60^\circ]$; equilateral triangle
	Third statement, leading to correct congruence condition i.e. RHS, SAS, SSA	B1	
	(ii) BFD	1	
	(iii) $\angle EBF = \angle DFB = 90^\circ$ Cointerior/interior/supplementary/allied angles [sum to 180] OR $\angle BEF = \angle EFD = 60^\circ$ Alternate angles [are equal]	1 1dep OR 1 1dep	Both 90° could be marked on diagram Both 60° could be marked on diagram
	(iv) 120°	1	120° could be marked on diagram
	(b) (i) 6.126 to 6.13	2	M1 for $\frac{1}{2} \times 4 \times 4 \times \sin 130$ Or $\frac{1}{2}PQ \times$ perpendicular height (numerical)
(ii)	38.2 to 38.3	3	M1 for $\frac{(360 - 130)}{360} \times \pi \times 4^2$ soi by 32.11 or $\frac{130}{360} \times \pi \times 4^2$ soi by 18.15 And M1 for ‘ <i>their</i> major sector area’ + ‘ <i>their</i> triangle area’ Or for ‘ <i>their</i> circle area’ – ‘ <i>their</i> minor sector area’ + ‘ <i>their</i> triangle area’

MARK SCHEME for the May/June 2015 series

4024 MATHEMATICS (SYLLABUS D)

4024/21

Paper 2 (Paper 2), maximum raw mark 100

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge O Level – May/June 2015	4024	21

Qu	Answers	Mark	Part Marks
1 (a) (i)	28 236	2	B1 for $\frac{22}{100}$ or $\frac{78}{100} \times 36\,200$ or 7964
(ii)	140 000	3	M1 for $\frac{8}{100}x = 36\,200 - 25\,000$ or figs $\frac{36\,200 - 25\,000}{8}$ Or B1 for figs $(36\,200 - 25\,000) \div 8$ or 11 200
(iii)	30	2	M1 for figs $\frac{1080 - 756}{1080}$
(b)	600	3	B1 for 0.135 soi M1 for figs $\frac{681}{113.5 \text{ or } 104.5}$
2 (a)	8.94	2	M1 for $\sqrt{(-1-3)^2 + (2-10)^2}$
(b)	– 0.447	2	M1 for $\frac{4}{\sqrt{80}}$
(c)	$x + 2y = 13$ oe correctly obtained	2	M1 for $(x - (1))^2 + (y - 2)^2 = (x - 3)^2 + (y - 10)^2$
(d)	(– 1, 7)	1	
3 (a) (i)	Convincing proof	1	
(ii) (a)	HFG	1	
(b)	$HEF + HFK = HEF + HFG$	1	
(b) (i)	(vertically) opposite same segment	2	B1 for either
(ii)	$\hat{PLM} = 180 - y$ $\hat{PRM} = 180 - (180 - y) = y$	2	B1 for either
(iii)	Similar justified	3	B1 for Similar B1 for both $\hat{MSQ}$ and $\hat{PMR}$
4 (a)	63.6 to 63.62	2	M1 for πr^2
(b)	352 to 353	2	B1 for 161(.2) or 190.9 or 191
(c)	10	2	M1 for $\frac{1}{3}\pi 5^2 h$ or $\frac{2}{3}\pi 5^3$

Page 3	Mark Scheme	Syllabus	Paper
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5	(a)	Correctly shown	2	M1 for $\tan x = \frac{4}{11}$
	(b)	Complete explanation	1	$\hat{BCA} = \hat{CDF}$ corresponding and $y + \hat{BCA} = 90 = x + \hat{CDF}$
	(c)	4.256 to 4.26(0)	3	M2 for $(AC =) \frac{4}{\cos y}$ Or M1 for $\frac{4}{AC} = \cos y$
	(d)	55.8 to 55.9	4ft	M3 for $\frac{1}{2}(\text{their (c)} + \text{their } FD) \times 7$ Or B2 for $(FD =) 11.7$ or $\sqrt{137}$ or $\sqrt{4^2 + 11^2}$ Or B1 for $(DF^2) = 4^2 + 11^2$
6	(a)	$x^3 - 1$	2	M1 for $x^3 + x^2 + x - x^2 - x - 1$
	(b)	0.4	3	M1 for $\frac{3x(x-2) - 4(x+2)}{(x+2)(x-2)} (= 3)$ B1 for $3x^2 - 6x - 4x - 8$ or $x^2 - 4$ soi
	(c)	$(x =) -0.5$ $(y =) -2$	4	B3 for one correct value with supporting working Or B2 for a pair of values satisfying one equation Or M1 for attempt to equate coefficients
7	(a) (i)	20.9 to 21(.0)	1	
	(ii)	4.6(0) to 4.61	1	
	(b) (i)	$3x^2 + 9x - 247 (= 0)$ correctly obtained	4	B3 for $16^2 = x^2 + 4x^2 + 12x + 9 - 2x^2 - 3x$ Or M2 for $16^2 = x^2 + (2x+3)^2 - 2x(2x+3)\cos 60$ Or M1 for $(16^2 =) x^2 + (2x+3)^2 \pm (2)x(2x+3)\cos 60$
	(ii)	7.70 and -10.70	3	B2 for one correct solution Or 7.69 to 7.70 and -10.69 to -10.70 Or if in the form $\frac{p \pm \sqrt{q}}{r}$, B1 for $p = -9$ and $r = 6$ or for $q = 3045$ (55.18)
	(iii)	7.70 18.40	1ft	
	(iv)	61.3 to 62(.0)	2ft	M1 for $\frac{1}{2} \times \text{their } 7.70 \times \text{their } 18.40 \times \sin 60$
8	(a) (i)	42.18 to 42.22	2	M1 for $\frac{260}{360}$ or $2\pi \times 9.3$

Page 4	Mark Scheme	Syllabus	Paper
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(ii)	196 to 196.32	2	M1 for $\frac{260}{360} \times \pi \times 9.3^2$
(b) (i)	194 to 195	2	M1 for subtraction of two areas
(ii) (a)	0.578 confirmed	2	M1 for $(2\pi r =) \frac{260}{360} \times 2\pi \times 0.8$
(b)	18.1 to 18.2	2	M1 for $2\pi \times 0.578 \times 5$
(c)	5.24 to 5.25	2	M1 for $\pi \times 0.578^2 \times 5$
9 (a)	–27 –8 –1 0 1 8 27	1	
(b)	7 correct plots and smooth curve	2	B1 for 5 plots
(c) (i)	– 2.4 to – 2.6	1	
(ii)	4 to 6	1	
(iii)	$t = u^3$	1	
(iv)	10 to 13	2	M1 for a tangent at $x = 2$
(d) (i)	Correct line	2	B1 for correct intercept (0, 3) or gradient 5
(ii)	(–1.95 to –1.7) (– 0.8 to –0.5) (2.4 to 2.6)	2	B1 for one correct
10 (a) (i)	$\frac{1}{3}$ oe	1	
(ii)	$\frac{48}{1495}$ oe	2	M1 for $(2 \times) \frac{60}{300} \times \frac{24}{299}$ After 0, allow SC1 for $2 \times \frac{60}{300} \times \frac{24}{300}$
(b)	50.8	3	M1 for 15240, or 2640+1880+2352+3744+3136+1488, or 44×60+47×40+49×48+52×72+56×56+62×24 B1 for division by 300
(c) (i)	100 148 220 276	1	
(ii)	7 correct plots and smooth curve	2	B1 for 5 correct plots
(d) (i)	50 to 50.5	1	
(ii)	7.25 to 8.00	2	B1 for 46.5 to 47.0 or 54.25 to 54.50 seen or <i>their</i> reading at 225, or 75 seen

Page 5	Mark Scheme	Syllabus	Paper
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11 (a) (i)	b	1	
(ii)	2 b correctly obtained	2	M1 for $\overrightarrow{GB} + \overrightarrow{BA} + \overrightarrow{AE} + \overrightarrow{ED}$ soi
(iii) (a)	$\frac{8}{5}\mathbf{a} - \frac{8}{5}\mathbf{b}$	2	B1 for $\overrightarrow{DC} = 2\mathbf{c} - 2\mathbf{b}$
(b)	1 : $\frac{8}{5}$ oe	1	
(b) (i) (a)	Reflection in $y = x$	2	B1 for reflection
(b)	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$	2	M1 for either column
(ii)	Vertices $(-3, 6)$ $(-3, 0)$ $(0, -2)$	1	
(iii)	90	1	

MARK SCHEME for the May/June 2015 series

4024 MATHEMATICS (SYLLABUS D)

4024/22

Paper 2, maximum raw mark 100

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	Cambridge O Level – May/June 2015	4024	22

Qu.	Answers	Mark	Part Marks
1 (a)	$\frac{17x+13}{6}$ cao final answer	2	M1 for $\frac{2(4x-1)}{6} + \frac{3(3x+5)}{6}$ or better oe
(b) (i)	$\frac{1}{2}$ or 0.5 cao	1	
(ii)	$y = 1$ final answer	1	
(iii)	Line from (6, 1) to (4, 3)	1	
(iv)	$y = -x + 7$ final answer	2	B1 for any equation with grad -1 and/or intercept 7
(v)	(0, 6)	2	B1 for line from (2, 2) with y-intercept between 5 and 7 soi Or for correct (unsimplified) equation ($y = -2x + 6$)
2 (a)	27	1	
(b)	Constant speed	1	
(c)	0.08 or $\frac{2}{25}$ final answer	1	
(d)	3 to 3.5	1	
(e)	1500	2	M1 for $\frac{1}{2}(200 + 50)12$ Or B1 for $\Delta = 900$ or rectangle = 600 After 0, allow SC1 for 1750
(f)	27 cao	2	M1 for <i>their</i> (total distance $\div$ total time) soi
3 (a) (i)	67.8	3	M1 for $15 \times 10 + 45 \times 15 + 75 \times 11 + 105 \times 7 + 135 \times 5 + 165 \times 2$ i.e. $150 + 675 + 825 + 735 + 675 + 330 (=3390)$ B1 for $\div 50$ (independent of M mark)
(ii)	$90 \leq t < 120$	1	Or clear equivalent
(b) (i)	100 <u>and</u> 76 <u>and</u> 48	2	B1 for 100 and 76, or for 48
(ii)	Completed pie chart with at least one sector correctly labelled	1	
4 (a) (i)	72	1	
(ii)	83	1	
(iii)	108	1	
(iv)	83	1FT	Their (ii)

Page 3	Mark Scheme	Syllabus	Paper
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(b) (i)	$4(\pi) \text{ cm}$	2	B1 for $\pi \times 6^2$ or for $\frac{40}{360}$
(ii)	$12 + \frac{4}{3}\pi$ final answer	2	B1 for $(a =) 12$, or for $(b =) \frac{4}{3}$
(iii)	8	1 ft	
5 (a)	$(\pm) 9.3(0) \text{ to } 9.31$	4	M2 for $BC^2 = 8^2 + 11^2 - 2 \times 8 \times 11 \cos 56$ Or M1 for $8^2 + 11^2 \pm (2) \times 8 \times 11 \cos 56$ B1 for 86.5 to 86.6
(b)	122.2 to 122.3	3	M2 for $(\sin ADC =) \frac{11 \sin 30}{6.5}$, or 57.7 to 57.8, or 58 Or M1 for $\frac{\sin ADC}{11} = \frac{\sin 30}{6.5}$ oe
(c)	45.7 to 45.71	4	B1 for 27.7 to 27.8 seen M1 for $\frac{1}{2} \times 11 \times 8 \times \sin 56 (= 36.478\dots)$ or for $8 \times \sin 56$ if using heights M1 for $\frac{\text{their stated area}}{\text{their area } ABC} \times 100$ or $\frac{\text{their height } ADC}{\text{their height } ABC} \times 100$
6 (a)	325	2	M1 for $\frac{250}{20500}$ or $\frac{26650}{20500}$ Or B1 for 82 seen
(b)	465 and 2.56 to 2.57	3	B2 for 465 or 2.56 to 2.57 seen Or M1 for 400×1.17 (468)
(c)	170	3	B2 for 420 or 144.5(0) Or M1 for $357 \div 0.85$ or $357 - (250 \times 0.85)$

Page 4	Mark Scheme	Syllabus	Paper
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SECTION B			
Qu.	Answers	Mark	Part Marks
7 (a) (i)	$f^{-1}(x) = \frac{3x-7}{2}$ oe final answer	2	M1 for $3y = 2x + 7$ or $3x = 2y + 7$ oe
(ii)	$m = -14$	2	M1 for $\frac{2m+7}{3} = \frac{m}{2}$ oe
(b) (i)	4, 4 and smooth correct graph drawn	3	B1 for 4 and 4 B1 for 7 correct plots
(ii)	(y =) 6.2 to 6.4	1	
(iii)	line drawn <u>and</u> $x = -0.7$ to -0.8 $x = 2.7$ to 2.8	2	M1 for correct line drawn
(iv)	line drawn <u>and</u> $x = -2.3$ to -2.7	2	M1 for horizontal line crossing curve at intersection of $x = 3.5$ and their curve or for the line $y = -2.75$
8 (a)	321	1	
(b)	9.43 to 9.44	2	M1 for $\sin 39 = \frac{y}{15}$ oe
(c)	19.3 to 19.31	2	B1 for $\cos 39 = \frac{15}{x}$ oe
(d) (i)	X marked 12cm from A on bearing of 141°	2	B1 for either a correct distance or bearing
(ii)	Correct region shaded	3	B1 for arc, min length 3 cm, radius 6 cm, centre A B1 for bisector of $\angle ABC$, min length 3 cm B1 for shading
(iii)	17.6 to 18.4 dependent on an acceptable X and Y	2	M1 for Y established at northern end of shading
9 (a) (i)	$2x(2x^2 - 5y)$ final answer	1	
(ii)	$(3a + b)(3a - b)$ final answer	1	
(b)	$m = \frac{5}{8}, 0.625$	2	M1 for $7 = 12 - 8m$ or $\frac{7}{4} = 3 - 2m$
(c) (i)	$h^2 + (h + 7)^2 = 23^2$ leading to correct rearrangement	2	M1 for $h^2 + (h + 7)^2 = 23^2$
(ii)	$\frac{h}{2} (h + 7)$ oe isw	1	

Page 5	Mark Scheme	Syllabus	Paper
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(iii)	120 cao	1	
(iv)	12.4, -19.4	3	B2 for one correct solution, or for 12.38 to 12.40 and -19.38 to -19.40 Or if in form $\frac{p \pm \sqrt{q}}{r}$, B1 for $p = -7$ and $r = 2$ and B1 for $q = 1009$ or $\sqrt{q} = 31.7$ to 31.8
(v)	54.76 to 54.8	1FT	
10 (a) (i)	Rotation 90° anticlockwise about (1,1)	2	B1 for Rotation B1 for 90° anticlockwise and about (1,1)
(ii)	Correct triangle	2	B1 for two correct vertices
(iii)	Correct triangle	2	B1 for two correct vertices
(iv)	24	2	B1 for 4^2 soi or M1 for $\frac{1}{2} \times 12 \times 4$
(b)	2	1	
(c)	4	1	
(d)	Rectangle, Rhombus	2	B1 for one correct
11 (a) (i)	$\frac{7}{30}$ or 0.23... or better	1	
(ii)	$\frac{11}{15}$ cao	1	
(iii) (a)	All probabilities correctly placed	2	B1 for at least 8 correct
(b)	$\frac{308}{870}$ or $\frac{154}{435}$ or 0.354	2	M1 for $\left(\text{their } \frac{7}{30} \times \text{their } \frac{6}{29} \right) + \left(\frac{15}{30} \times \text{their } \frac{14}{29} \right)$ $+ \left(\frac{8}{30} \times \text{their } \frac{7}{29} \right)$
(b) (i)	Correct histogram	3	B2 for at least 3 correct bars Or B1 for at least 1 correct bar or correct frequency densities seen
(ii)	61 or 62	2	B1 for 6 or 7 seen
(iii)	10	1	



Cambridge International Examinations
Cambridge Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2016

MARK SCHEME

Maximum Mark: 100

Published

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge O Level – May/June 2016	4024	21

Question	Answers	Mark	Part Marks
1 (a)	7.5(0)	2	M1 for $x + \frac{60x}{100} = 12$ soi or B1 for $\div$ by 160
(b)	45	2	M1 for $\frac{17.40-12}{12} \times 100$
(c)	35	2	M1 for $\frac{17.4-11.31}{17.4} \times 100$
(d)	25	3	M1 for $60 \times 17.4 + x \times 11.31 (\geq 1320)$ or B1 276 A1 for 24.4(03...)
2 (a)	6	2	M1 for $p - 1 = 5(7 - p)$ soi
(b)	$\frac{3b^2}{a}$	2	M1 for $\frac{9b^4}{a^2}$ oe $\frac{3a^{\frac{1}{2}}b^3}{a^{\frac{3}{2}}b}$ oe or B1 for $3b^2$ as numerator or $\frac{k}{a}$
(c)	$\frac{q^2}{3}$	2	B1 for $q^2(1-q)$ or $3(1-q)$
(d) (i)	$(4t-1)(t+9)$	2	B1 for $(at+c)(bt+d)$ with $ab = 4$ or $cd = -9$
(ii)	$\frac{1}{4} - 9$ or ft	1ft	
3 (a)	Correct graph	2	B1 for correct scales and 4 points or wrong scales and all points.
(b) (i)	-2.3 ± 0.5 1.3 ± 0.5	1	
(ii)	-2.8 ± 0.5 1.8 ± 0.5	2	M1 for $x^2 + x - 3 = 2$ soi
(c)	2.4 to 3.6	2	M1 for tangent at $x=1$
(d) (i)	$y = 2x - 2$	2	B1 for $2x$ or -2
(ii)	-0.6 1.6	2	Dependent on line drawn B1 for their line having FT gradient or FT intercept

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge O Level – May/June 2016	4024	21

Question	Answers	Mark	Part Marks
4 (a)	Complete proof	3	B2 for 2 pairs of equal angles 1 pair with reason. B1 for 1 pair of equal angles.
(b) (i)	2 : 5	2	B1 for $NM : BL = 2 : 3$ oe or $NM = LC$
(ii)	4 : 9	1	
(iii)	1 : 3	2	B1 for such as $\frac{\Delta ANM}{\Delta ABC} = \frac{4}{25}$ or $\frac{\Delta NBL}{\Delta ABC} = \frac{9}{25}$
5 (a)	15.1 or 15.08(.....	3	M1 for $\tan \theta = \frac{31}{115}$ or $\tan \theta = \frac{115}{31}$ A1 for $\theta = 15.1$ or $\theta = 74.9$
(b) (i)	18.8 or 18.77(.....	2	M1 for $\sin \theta = \frac{354}{1100}$
(ii)	251 or 251.2(.....	1ft	270 – their LJK final ans.
6 (a)	$\begin{pmatrix} 6 & -2 \\ -5 & 11 \end{pmatrix}$	2	B1 for at least 2 elements correct in a 2 x 2 matrix
(b)	$\begin{pmatrix} 15 & -7 \\ 7 & 8 \end{pmatrix}$	2	B1 for at least 2 elements correct or M1 for $\begin{pmatrix} 4 & -1 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} 4 & -1 \\ 1 & 3 \end{pmatrix}$ soi
(c)	$-\frac{1}{10} \begin{pmatrix} -5 & 0 \\ -7 & 2 \end{pmatrix}$ oe isw	2	B1 for $\det B = -10$ soi or $\begin{pmatrix} -5 & 0 \\ -7 & 2 \end{pmatrix}$
(d)	$\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$	1	
(e)	$\begin{pmatrix} 0 & 0 \\ 7 & -7 \end{pmatrix}$	2	B1 for $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ soi

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge O Level – May/June 2016	4024	21

Question	Answers	Mark	Part Marks
7 (a)	4.53 to 4.54	4	B2 for $BOC = 52$ or after B0 B1 for $\hat{ABC} = 90$ or triangle OBC isosceles or $\hat{BAC} = 26$ M1 for $\frac{52}{360} \times 2\pi 5$ ft
(b) (i)	101 or 32π or 100 to 100.6	2	M1 for $\pi(16.52)$ or 15.5^2
(ii)	0.87 to 0.871	3	B1 for $\pi 15.5^2$ or $44\pi r^2$ and M1 for $r^2 = \frac{\pi 15.5^2 - 650}{44\pi}$
(iii)	7	3	M1 for $\pi 15.5^2 d = 500$ A1 for 0.66 to 0.663
8 (a) (i)	-1.92 (3.....	1	
(ii)	$\frac{8}{p+5}$	2	M1 for $\frac{8}{q} = p+5$ or $pq = 8-5q$ or $p = \frac{8}{q} - 5$
(b) (i)	H and h correctly derived	2	M1 for correct substitution in the formula for the area of a trapezium.
(ii)	$\frac{75}{(x-1)(2x+3)}$ correctly derived	3	M1 for $\frac{15(2x+3) - 30(x-1)}{(x-1)(2x+3)}$ soi B1 for $30x + 45 - 30x + 30$ soi
(iii) (a)	Equation correctly derived.	2	B1 for $\frac{75}{(x-1)(2x+3)} = 1.5$
(b)	4.90	2	B1 for $\sqrt{1^2 - 4 \times 2 \times (-53)}$ soi or B1 for $\frac{-1 \pm \sqrt{their 425}}{2 \times 2}$ soi

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge O Level – May/June 2016	4024	21

Question	Answers	Mark	Part Marks
9 (a) (i)	5.38 to 5.39 or $\sqrt{29}$	2	M1 for $(AC^2) = 2^2 + 5^2$
(ii)	0.517 to 0.518	2	M1 for $\frac{CE}{2} = \sin 15^\circ$ oe
(iii)	68.8 to 68.9	4	M1 for $\frac{AF}{2} = \cos 15^\circ$ oe or $BC^2 = BE^2 + (\text{their } CE)^2$ or any complete alternative method A1 for 1.932 and M1 for $\tan \hat{FAE} = \frac{5}{2 \cos 15^\circ}$ oe or $\frac{5}{\text{their}(AF)}$
(b) (i)	80.9(4.... Or 81	3	B1 for $10^2 = 6^2 + 9^2 - 2 \times 6 \times 9 \times \cos \theta$ or B2 for $\cos \theta = \frac{9^2 + 6^2 - 10^2}{2 \times 9 \times 6}$
(ii)	>	1	
10 (a)	(2) (4) 14 54 84 98 (100)	1	
(b)	Correct curve	2	P1 for at least 5 correct plots
(c) (i)	195 ft $190 \leq$ and < 200	1	
(ii)	50 – 75	2	B1 for one quartile correct in ranges 225 to 235 or 160 to 175
(d)	Correct curve	4	P3 for at least 4 correct plots or B1 + B1 for any two correct points soi.
(e)	92 ft	1	
(f)	B 15 ft A	1ft	Their 90 – 75

Page 6	Mark Scheme	Syllabus	Paper
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Question	Answers	Mark	Part Marks
11 (a)	$\begin{pmatrix} -6 \\ 2 \end{pmatrix}$	1	
(b) (i)	$\begin{pmatrix} 8 \\ 4 \end{pmatrix}$	2	B1 for $\begin{pmatrix} 8 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 4 \end{pmatrix}$
(ii)	$\begin{pmatrix} -8 \\ -4 \end{pmatrix}$ ft	1	
(iii)	8.94 or 8.94 to 8.95 or $\sqrt{80}$ oe	2	M1 for $\sqrt{(-8)^2 + (-4)^2}$ oe ft
(c) (i)	Triangle vertices (5,4), (13,0), (9,8)	2	B1 for 2 correct
(ii)	Triangle <i>F</i> (5,4), (7,3), (6,5)	1	
(iii)	Rotation 180 Centre (5,4)	3	B2 for Rotation with either centre or angle. B1 for Rotation.



Cambridge International Examinations
Cambridge Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2016

MARK SCHEME

Maximum Mark: 100

Published

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge O Level – May/June 2016	4024	22

Question	Answers	Mark	Part marks
1 (a)	41 472 or 41 470 or 41 500 cao	1	
(b)	\$65 (not from 64.84 rounded)	2	M1 for $1.05x = 68.25$ soi
(c)	7.50 – 7.60	3	[M2 for 1.05×1.024 oe] or M1 for $40500 \times \textit{their} 65 [=2\,632\,500]$ and M1 <i>their</i> $41\,472 \times 68.25 [=2\,830\,464]$
2 (a) (i)	$\begin{pmatrix} 5 \\ 6 \end{pmatrix}$	1	
(ii)	4.47 – 4.473 or 4.5 or $\sqrt{20}$ or $2\sqrt{5}$	2	M1 for $\sqrt{((\pm 4)^2 + (\pm 2)^2)}$
(b) (i)	(a) $\frac{1}{2}\mathbf{b} - \mathbf{a}$ or $\frac{1}{2}(\mathbf{b} - 2\mathbf{a})$ or equivalent two term answers final answer	1	
	(b) $\frac{3}{2}\mathbf{b} - 3\mathbf{a}$ or $3(\frac{1}{2}\mathbf{b} - \mathbf{a})$ or $\frac{3\mathbf{b} - 6\mathbf{a}}{2}$ or equivalent two term answers final answer	1	
(ii)	3 : 1 cao	1	Dependent on correct (b)(i)(a) and (b)(i)(b)
3 (a) (i)	1.64 or $1\frac{16}{25}$	2	M1 for $\frac{0 \times 7 + 1 \times 5 + 2 \times 6 + 3 \times 4 + 4 \times 3}{7 + 5 + 6 + 4 + 3}$
(ii)	2	1	
(iii)	0	1	
(b)	appropriate reason	1	
(c)	$\frac{1}{30}$ cao	2	M1 for $\frac{5}{25} \times \frac{4}{24}$ oe
(d)	Correct bar chart with axes labelled	2	B1 if only one error (eg incorrect height, scales missing / incorrect, inconsistent bar widths, or 4 correct bars)
(e)	0 0 1 3 4	1	
4 (a) (i)	Correct triangle with arcs shown	2	B1 for correct triangle with no arcs or triangle with one side correct length with arcs or triangle with $BC = 7$ and $AC = 12$ with arcs (reflection)
(ii)	104 to 108	1	

Page 3	Mark Scheme	Syllabus	Paper
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Question	Answers	Mark	Part marks
(b)	150°	2	M1 for $180 - (360 \div 12)$ or $(180 \times (12-2)) \div 12$
(c) (i)	110°	1	
(ii)	165°	2ft	ft $\frac{3}{2} \times \text{their } p$ provided $p < 120$ and $p \neq 90$ B1 for 30, 15 or 75 seen
(d)	$\frac{27}{4}x^2$ final answer	3	<u>EITHER</u> B2 for $\frac{1}{2}(6x+3x)\frac{3x}{2}$ oe or B1 for $PQ = 3x$ <u>OR</u> B1 for $3x^2$ (area of small trapezium) B1 for their $3x^2 \times \left(\frac{3}{2}\right)^2$ oe <u>OR</u> If $AB = x$ used SC2 for $\frac{27}{16}x^2$ or SC1 for $\frac{27}{16}$
5 (a)	$4x^2(2y-3x^3)$ final answer	1	
(b)	$x = 6.5$ or $\frac{13}{2}$ or $6\frac{1}{2}$	2	M1 for $4x - 2x - 10 = 3$ or better
(c)	$y > -2.6$ or $y > -\frac{13}{5}$ or $y > -2\frac{3}{5}$ final answer	2	M1 for $-5y < 20 - 7$ oe or better Or SC1 for 2.6 or -2.6 oe seen
(d) (i)	<u>EITHER</u> Width = $\frac{18-4x}{2}$ oe $\frac{18-4x}{2} \times 2x = 10$ oe <u>OR</u> Width = $\frac{10}{2x}$ oe $4x + \frac{20}{2x} = 18$ oe	M1 A1	 isw
(ii)	3.85 and 0.65 cao	3	B2 for 3.850 to 3.851 and 0.649 to 0.650 or one correct answer or 3.9 and 0.6 Or if in form $\frac{p \pm \sqrt{q}}{r}$ or $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$ B1 for $p = 9$ and $r = 4$ or $q = 41$

Page 4	Mark Scheme	Syllabus	Paper
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Question	Answers	Mark	Part marks
(iii)	6.35 to 6.45 or – 6.45 to – 6.35 oe	1	
6	(a) (i)	1	
	(b) 9	1	
	(c) 3,5,7,11	1	
	(ii) $\frac{4}{11}$ oe isw	1ft	
	(b) (i) $\begin{pmatrix} 8 & 0 \\ 3 & 1 \end{pmatrix}$ final answer	2	
	(ii) $\frac{1}{4}\begin{pmatrix} 1 & -2 \\ 1 & 2 \end{pmatrix}$ oe isw	2	B1 for $k\begin{pmatrix} 1 & -2 \\ 1 & 2 \end{pmatrix}$ or $\frac{1}{4}\begin{pmatrix} a & b \\ c & d \end{pmatrix}$
	SECTION B		
7	(a)	1	B2 for at least 6 correct plots B1 for at least 3 correct plots If 0 SC2 for consistent horizontal translation to the left of all points or SC1 for consistent horizontal translation to the left of all points with one slip B2 for at least 4 correct points plotted B1 for at least 2 correct points plotted Dep on 2 nd B1; an answer of 40 needs to be confirmed by checking graph
	(b)	3	
	(c) (i)	1ft	
	(ii)	1ft	
	(d)	3	
	(e)	B1 B1 B1	
8	(a)	1	B1 for at least 4 correct points B1 for tangent drawn at $x = 4$ or B1 for gradient 2.3 to 3.0
	(b)	2	
	(c)	2	
	(d) (i)	1	

Page 5	Mark Scheme	Syllabus	Paper
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Question	Answers	Mark	Part marks
(ii)	2.3 to 2.4 dep on line drawn	2	B1 for $2x + y = 6$ drawn
(e) (i)	$\frac{1}{3}$ or 0.33..	1	
(ii)	Tangent gradient roughly $\frac{1}{3}$	1	
(iii)	$y = \frac{1}{3}x + k$ oe where $0 < k < 0.25$	2ft	Ft from their e(i) B1 for $\frac{1}{3}x + k$ oe where $0 < k < 0.25$ or $y = \frac{1}{3}x + k$ oe (any k outside range)
9 (a)	173.8 to 174m	3	B1 for 9 and 115 soi M1 for $\frac{AB}{\sin 115} = \frac{30}{\sin 9}$ or better
(b)	51.4 to 51.5	4	B3 for 38.5 to 38.6 or M2 for $\cos DFE = \frac{75^2 + 180^2 - 130^2}{2 \times 75 \times 180}$ or M1 for $130^2 = 75^2 + 180^2 - 2 \times 75 \times 180 \cos F$
(c) (i)	188 to 189	1	
(ii)	169 to 170.2 km/h	2	M1 for $15 \times \text{their } 188$ seen
(iii)	15.67 to 16.0	2	M1 for $\frac{90}{2\pi}$ (= 14.3)
10 (a)	$a = 3$ $b = 5$	2	B1 for one correct
(b)	$\begin{pmatrix} -6 \\ 3 \end{pmatrix}$ or $3 \begin{pmatrix} -2 \\ 1 \end{pmatrix}$	1	
(c)	Reflection, $y = x$	2	B1 for reflection or B1 for $y = x$ only
(d)	Enlargement, Scale factor -2 , centre $(-4, 2)$	3	B1 for enlargement / negative enlargement B1 for scale factor -2 B1 for centre $(-4, 2)$
(e)	$\begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} \end{pmatrix}$ oe	1	

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge O Level – May/June 2016	4024	22

Question	Answers	Mark	Part marks
(f) (i)	$(-h, -g)$	1	
(ii)	Reflection $y = -x$	2	B1 for reflection or B1 for $y = -x$ only
11 (a) (i)	5.06 to 5.08	4	B1 for $r + 3.5$ seen B1 for $\pi(r + 3.5)^2 - \pi r^2$ or $20\pi(r + 3.5)^2 - 20\pi r^2$ B1 for $20\pi(r + 3.5)^2 - 20\pi r^2 = 3000$ or better
(ii)	Solid II by 2.5 – 2.6	4	B3 11.25 to 11.3 cm or M1 for $\frac{1}{3} \times \pi r^2 \times 2r = 3000$ or better and M1 for $r^3 = \frac{3000 \times 3}{2 \times \pi}$ (= 1432)
(b)	630 to 632	4	M1 for $\frac{1}{2} \times 8 \times 8 \times \sin 60$ or $\frac{1}{2} \times 8 \times \sqrt{48}$ oe M1 for 8×24 soi or 192 soi M1 for $3 \times 8 \times 24 + 2 \times$ <i>their</i> (triangle area)



Cambridge International Examinations
Cambridge Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2017

MARK SCHEME

Maximum Mark: 100

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Question	Answers	Mark	Partial marks
1(a)	4 : 2 : 3 final answer	2	B1 for 24 : 12 : 54 – (24+12) or 12 : 6 : 9
1(b)	$c = 14$, $v = 2$ and $t = 13$	2	B1 for 2 correct or 10 cars, 10 vans and 5 trucks soi
2(a)	36 000	2	M1 for seeing 36720 as 102[%]
2(b)	12.3	4	B1 for 14 688 or 40% B1 for 5508 or 32.6[%] to 32.7[%] or 0.326 to 0.327 M1 for $\frac{36720 - \text{their}14688 - \text{their}5508 - 12000}{36720}$ or $100 - (15 + \text{their}32.7 + \text{their}40)$
3(a)	GCB, HPC, HPB, HCB, RPC, RPB, RCB	2	B1 for 5 correct and none incorrect or for 6 correct
3(b)(i)	$\frac{3}{9}$ or $\frac{1}{3}$ or 0.333(..) or 33.3(..)%	1	FT dep on B1 scored in (a)
3(b)(ii)	$\frac{6}{9}$ or $\frac{2}{3}$ or 0.666 – 0.667 or 66.6% – 66.7%	1	FT dep on B1 scored in (a)
3(b)(iii)	$\frac{2}{9}$ or 0.222(...) or 22.2(...)%	1	FT dep on B1 scored in (a) After 0 scored in (i) (ii) and (iii), SC1 for $\frac{3}{k}, \frac{6}{k}, \frac{2}{k}$
4(a)(i)	$\begin{pmatrix} 0 & 1 \\ 8 & 1 \end{pmatrix}$	2	B1 for $\begin{pmatrix} 0 & 1 \\ 8 & 1 \end{pmatrix}$ or 2 elements correct in a 2×2 matrix with brackets
4(a)(ii)	$\frac{1}{4} \begin{pmatrix} -1 & 1 \\ -6 & 2 \end{pmatrix}$ oe isw	2	B1 for for determinant = 4 soi or $k \begin{pmatrix} -1 & 1 \\ -6 & 2 \end{pmatrix}$
4(b)	$\frac{1}{2} \begin{pmatrix} 4 & -3 \\ 14 & -2 \end{pmatrix}$ or $\begin{pmatrix} 2 & -1.5 \\ 7 & -1 \end{pmatrix}$ oe	2	B1 for $2\mathbf{C} = 3\mathbf{B} - \mathbf{A}$ or $-2\mathbf{C} = \mathbf{A} - 3\mathbf{B}$ soi or $\begin{pmatrix} 4 & -3 \\ 14 & -2 \end{pmatrix}$ or M1 for $\begin{pmatrix} 2 & 0 \\ 4 & -1 \end{pmatrix} + 2\mathbf{C} = 3 \begin{pmatrix} 2 & -1 \\ 6 & -1 \end{pmatrix}$
5(a)	17	1	
5(b)	Smooth curve through 7 correct points	3	Mark the curve first B2 for at least 5 ft plots correct B1 for at least 4 ft plots correct

Question	Answers	Mark	Partial marks
5(c)	-1.7 to -1.4 , -0.5 to -0.2 , 1.7 to 2.0	2	FT B1 for 2 correct
5(d)	3 to 5 with tangent drawn	2	B1 for ruled solid tangent drawn
5(e)(i)	Correct ruled line drawn	1	
5(e)(ii)	$a = 7$, $b = 4$	2	B1 for one correct or $a = 6.8$ to 7.2 <u>and</u> $b = 3.8$ to 4.2
5(e)(iii)	-2.4 to -2.1 or -0.7 to -0.5	1	FT
6(a)(i)	$14.4[2\dots]$	2	M1 for $12^2 + 8^2$
6(a)(ii)	128.6° to 129°	3	M1 for $\tan \theta = \frac{12}{15}$ or $\tan \theta = \frac{15}{12}$ A1 for 38.6 to 38.7 or 51.3 to 51.4 After A0, SC1 for $90 + \tan^{-1}(\frac{12}{15})$ evaluated or $180 - \tan^{-1}(\frac{15}{12})$ evaluated
6(b)(i)	472 to 488	2	B1 for 6.3 to 6.5 seen
6(b)(ii)	F correctly placed	2	M1 for either $TF = 6$ cm plotted or correct angle
6(b)(iii)	242° to 248°	1	
7(a)	$3ab(4a - 5b^2)$	1	
7(b)(i)	$(2x + 3)^2$ isw	1	
7(b)(ii)	2, -5	2	M1 for $2x + 3 = (\pm)\sqrt{49}$ soi
7(c)	$\frac{p+5}{4}$ final answer	3	M2 for $\frac{4p+4-2p+6}{8}$ or $\frac{2p+2-p+3}{4}$ soi M1 for $\frac{4(p+1)-2(p-3)}{2 \times 4}$ or $\frac{2(p+1)-(p-3)}{4}$ After 0, SC1 for answer $\frac{p-1}{4}$ or $2p + 10$ or $p + 5$
7(d)	$m < -\frac{5}{6}$, $m < -0.833[\dots]$ final answer	2	M1 for $6m + 8 < 3$ or $3m + 4 < \frac{3}{2}$

Question	Answers	Mark	Partial marks
SECTION B			
8(a)	Correct diagram	1	
8(b)	22 26 88 130	2	B1 for 2 or 3 correct
8(c)	$4n + 6$ oe isw	2	B1 for $4n \pm k$
8(d)	26	1	
8(e)	$(2n + 3)(2n + 2)$ leading to $4n^2 + 10n + 6$ with no errors	2	B1 for either $(2n + 3)$ or $(2n + 2)$ used After 0, SC1 for $4n^2 + 10n + 6$ shown using alternative method
8(f)	$4n^2 + 6n$ oe	1	
8(g)	7 cao	3	M1 for $4p^2 + 10p + 6 = 8 \times \text{their } (4p + 6)$ A1 for $4p^2 - 22p - 42 [= 0]$ oe or B2 for $[p = 7]$ total 272 grey 272 or B1 for $[p = 6]$ total 240 grey 240
9(a)	140°	2	M1 for $180 - (360 \div 9)$ or $180(9 - 2) \div 9$
9(b)(i)	21.89.... with at least $7^2 + 18^2 - 2 \times 7 \times 18 \times \cos 115$ seen	3	M1 for $7^2 + 18^2 - 2 \times 7 \times 18 \times \cos 115$ A1 for 479.5 or $373 + 106.49..$ or $373 + 106.5$
9(b)(ii)	18.8° to 19°	3	M2 for $\sin B = \frac{11 \sin 28}{16}$ or M1 for $\frac{\sin B}{11} = \frac{\sin 28}{16}$ oe
9(b)(iii)	95.47° to 95.5°	4	B3 for 84.5 to 84.6 or M2 for $\sin E = \frac{109 \times 2}{\text{their } DE \times 21.9}$ or M1 for $109 = \frac{1}{2} \times 21.9 \times \text{their } DE \times \sin E$
10(a)(i)	60° angle at centre is twice angle at circumference	2	B1 for either correct
10(a)(ii)	70°	3	B2 for $y = 20$ or B1 for $\hat{OAB} = 30$ or $\hat{OBA} = 30$ or 240
10(a)(iii)	110°	1	FT 180 – (a)(ii) provided not negative answer

Question	Answers	Mark	Partial marks
10(b)(i)	$\frac{120}{360}\pi(r+4)^2 = \pi r^2$ $r^2 + 8r + 16 = 3r^2$ leading to $r^2 - 4r - 8 = 0$ without error	3	B1 for $\frac{120}{360}\pi(r+4)^2$ M1 for forming equation and expanding $(r+4)^2$
10(b)(ii)	$r = 5.46$ to 5.47	3	B2 for $\frac{-(-4) \pm \sqrt{(-4)^2 - 4 \times 1 \times -8}}{2}$ oe or B1 for $\frac{-(-4) \pm \sqrt{p}}{2 \times 1}$ oe or $\frac{q \pm \sqrt{(-4)^2 - 4 \times 1 \times -8}}{r}$ oe
11(a)	75 nfww	3	M2 for $\frac{\sum \text{frequency} \times \text{midvalue}}{80}$ oe or M1 for $\sum fc$
11(b)	25, 46, 64, 73, 78	1	
11(c)	8 points correctly plotted and joined	2	FT increasing curve B1 for at least 6 points correctly plotted
11(d)(i)	74 to 76	1	
11(d)(ii)	36 to 44	2	B1 for 52 to 56 <u>and</u> 92 to 96 seen
11(e)	54 to 62	3	B1 for 27 to 29 M1 for attempt to read at $(80 - 2 \times \text{their } 28)$
12(a)(i)	D correctly placed to the left of AC	2	B1 for $DA = 9$ or $CD = 7$
12(a)(ii)	44° to 48°	1	FT
12(a)(iii)(a)	2.9 to 3.1	1	
12(a)(iii)(b)	19.1 to 20.8	2	B1 for 13.2 to 13.4 seen
12(b)(i)	Opposite angles are both obtuse or both acute so their total is not 180 Or opposite angles are not supplementary	1	

Question	Answers	Mark	Partial marks
12(b)(ii)(a)	Correct region shaded		B1 for arc 6 cm from R B1 for angle bisector of Q B1 for perpendicular bisector of PR After B2, SC1 for ‘correct’ region shaded provided only slight inaccuracy with the other line/curve
12(b)(ii)(b)	7.9 to 8.3	1	FT



Cambridge International Examinations
Cambridge Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2017

MARK SCHEME

Maximum Mark: 100

Published

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This document consists of **8** printed pages.

Question	Answers	Marks	Part marks
1(a)	9370	3	M1 for (1199×5) or B1 for 5995 or 2398 <u>and</u> 3597 <u>and</u> M1 for $14(55 \times 2 + 40 \times 3)$ oe or B1 for 3220 or 1540 <u>and</u> 1680
1(b)	Bonus [cars] and 67	3	B2 for 67 or answer Bonus <u>with</u> 588 <u>and</u> 655 seen as total charged or M1 for 42×14 or $20 \times 14 + 750 \times 0.5$ [0]
2(a)	138 404 000 or 1.38404×10^8 isw	1	
2(b)	Thailand	1	
2(c)	$4.95[12] \times 10^7$ final answer	1	
2(d)	1.639 to 1.64	2	M1 for $\frac{188169[000] - 185133[000]}{185133[000]} [\times 100]$ oe or $\frac{188169[000]}{185133[000]} \times 100$
2(e)	15 400 000 oe final answer nfw	3	M2 for $15\,677\,000 \div \frac{100 + 1.68}{100}$ oe or M1 for seeing 15 677 000 as 101.68[%]
3(a)	- - - - - - 6 8 3 6 9 12 4 8 12 16	2	B1 for at least 6 correct
3(b)	$\frac{5}{16}$ or 0.3125 or 31.25%	1	FT <i>their</i> complete table (decimals or percentages correct to at least 3sf)

Question	Answers	Marks	Part marks
3(c)	$\frac{3}{4}$ cao	2	B1 for $\frac{12}{16}$ or $\frac{6}{8}$ or $\frac{their 12}{16}$ oe
3(d)	No with square 6 and factors 7 seen or square $\frac{6}{16}$ and factors $\frac{7}{16}$ seen or 1 4 4 4 9 16 and 1 2 2 3 3 6 6 seen or $1^2 2^2 2^2 2^2 3^2 4^2$ and 1 2 2 3 3 6 6 seen	2	B1 for square $\frac{6}{16}$ or factors $\frac{7}{16}$ or 1 4 4 4 9 16 seen or $1^2 2^2 2^2 2^2 3^2 4^2$ seen or 1 2 2 3 3 6 6 seen or square 6 and factors 7
4(a)	$\begin{pmatrix} 1 & 0 \\ 8 & 8 \end{pmatrix}$	2	B1 for 2 or 3 elements correct
4(b)	$\begin{pmatrix} -7 \\ 5 \end{pmatrix}$	2	B1 for $\begin{pmatrix} -7 \\ 5 \end{pmatrix}$ or $\frac{-7}{5}$ or $\begin{pmatrix} -7 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 5 \end{pmatrix}$ or $(-7 \text{ [] } 5)$
4(c)	$\begin{pmatrix} 2 & 1 \\ -2 & -\frac{1}{2} \end{pmatrix}$ or $\frac{1}{2} \begin{pmatrix} 4 & 2 \\ -4 & -1 \end{pmatrix}$ oe isw	3	B2 for $\frac{1}{2} \begin{pmatrix} -2 & -2 \\ 4 & 3 \end{pmatrix}$ oe or B1 for determinant = 2 soi or $k \begin{pmatrix} -2 & -2 \\ 4 & 3 \end{pmatrix}$
5(a)	$\frac{9}{10x}$ final answer	1	
5(b)	$7x - 5y + 3$ final answer	2	B1 for $7x - 5y + 3$ seen or two of $7x, -5y, 3$ in final answer
5(c)	-1.14, 1.47 final answers	3	B2 for $\frac{-(-1) \pm \sqrt{(-1)^2 - 4 \times 3 \times -5}}{2 \times 3}$ oe or B1 for $\frac{-(-1) \pm \sqrt{p}}{2 \times 3}$ oe or $\frac{q \pm \sqrt{(-1)^2 - 4 \times 3 \times -5}}{r}$ oe

Question	Answers	Marks	Part marks
5(d)(i)	Ruled line through (0,2.5) and (5, 0)	2	B1 for ‘correct’ freehand line or line with a gradient of -0.5 or line through (0, 2.5) with negative gradient or line through (5, 0) with negative gradient
5(d)(ii)	Correct region unambiguously identified	1	FT provided <i>their</i> straight line with negative gradient and the 3 given lines form a quadrilateral below $y = 4$
6(a)	7.387 to 7.392	2	M1 for $\sin 38 = \frac{PQ}{12}$ soi or $\frac{PQ}{\sin 38} = \frac{12}{\sin 90}$ soi
6(b)	71(.0) to 71.02, 108.98 to 109(.0) nfww	4	B3 for one correct or M2 for $\sin S = \frac{12\sin 52}{10}$ or $\frac{12\cos 38}{10}$ or M1 for $\frac{\sin S}{12} = \frac{\sin 52}{10}$ oe or [PR=]12cos38 or [PR=]12sin52 or [PR=] $\sqrt{12^2 - (their(a))^2}$ <u>and</u> SC1 for two answers that add to 180
7(a)	Correct pattern drawn	1	
7(b)	15 21 10 15	2	B1 for 2 or 3 correct
7(c)	n^2 oe final answer	1	e.g. $(\frac{1}{2}n^2 + \frac{1}{2}n) + (\frac{1}{2}n^2 - \frac{1}{2}n)$
7(d)	465	1	

Question	Answers	Marks	Part marks
7(e)	$n^2 - \left(\frac{1}{2}n^2 + \frac{1}{2}n\right)$ or $\left(\frac{1}{2}(n-1)^2 + \frac{1}{2}(n-1)\right)$ or $\left(\frac{1}{2}n^2 + \frac{1}{2}n\right) - n$ leading to $\left(\frac{1}{2}n^2 - \frac{1}{2}n\right)$ without error AG	1	
7(f)	$m = 9$ cao	3	M1 for $\frac{1}{2}m^2 + \frac{1}{2}m = 5m$ A1 for $m^2 - 9m = 0$ or $m^2 = 9m$ or $m - 9 = 0$ or $m + 1 = 10$ or B2 for $[m = 9] 5m = 45$ and crosses = 45 or B1 for values for $5m$ and the number of crosses seen for at least $m = 7$ and 8 After 0, SC1 for answer 11
SECTION B			
8(a)	14.96 to 15[.0] nfww	3	M2 for $15.1^2 - 2^2 (= 224.01)$ or M1 for $DC^2 + 2^2 = 15.1^2$ or $15.1^2 - \text{their } 2^2$ with horizontal line seen or B1 for horizontal line and 2 soi
8(b)	97.46 to 97.55	3	M2 for $\cos [A] = \frac{9^2 + 11^2 - 15.1^2}{2 \times 9 \times 11}$ oe or B1 for $15.1^2 = 9^2 + 11^2 - 2 \times 9 \times 11 \times \cos [A]$ oe

Question	Answers	Marks	Part marks
8(c)	123.8 to 124.1 nfw	4	M3 for $\frac{1}{2} \times 9 \times 11 \times \sin(b) + \frac{1}{2} \times (4 + 6) \times (a)$ oe with (a) $\neq 15.1$ soi or M1 for $\frac{1}{2} \times 9 \times 11 \times \sin(b)$ oe soi and M1 for $\frac{1}{2} \times (4 + 6) \times (a)$ oe with (a) $\neq 15.1$ soi
8(d)	495.5 to 497	2	FT (c) $\times 4$ B1 for (figs 5) ² soi
9(a)	$(x + 2)(10 - x)$ $= 10x + 20 - x^2 - 2x$ $y = 20 + 8x - x^2$ AG	2	B1 for (x + 2) and (10 - x) seen
9(b)	Smooth curve through 11 correct integer points	4	B3 for 6 or 7 correct integer points plotted or B2 for 4 or 5 correct integer points plotted or B1 for 2 or 3 correct integer points plotted
9(c)	9.1 to 9.4 with $y = x$ drawn	2	B1 for $y = x$ drawn or 9.1 to 9.4 with no line drawn/wrong line drawn
9(d)	-3, 6	4	B1 for $5x + 2$ soi M1 for <i>their</i> $(5x + 2) = 20 + 8x - x^2$ leading to $x^2 - 3x - k$ [=0] or $x^2 - kx - 18$ [=0] or equivalent 3 term quadratic A1 for $(x + 3)(x - 6)$ [=0] or $\frac{3 \pm \sqrt{3^2 - 4 \times 1 \times -18}}{2 \times 1}$ oe or $\frac{3}{2} \pm \sqrt{\frac{81}{4}}$ oe After A0, SC1 for answer 6 or -3

Question	Answers	Marks	Part marks
10(a)(i)	B and C correctly placed	3	B2 for B or C correctly placed or B1 for a point on a bearing of 062° or a point on a bearing of 194°
10(a)(ii)	D on BC with $ADB = 90^\circ$	1	FT
10(a)(iii)	2.7 to 3.1	1	dep on (a)(ii) and B or C correct
10(a)(iv)	1.2 to 1.4 oe	2	dep on (a)(ii) and B or C correct B1 for $[CD]$ 5.5 to 6 and $[DB]$ 7.3 to 7.7 or SC1 for answer $0.5 \leq n < 1$ if <i>their</i> $CD > \text{their } DB$ or answer $1 < n \leq 2$ if <i>their</i> $CD < \text{their } DB$
10(a)(v)	$0.714w$ to $0.834w$ oe or $k - w$ where k is 18 to 20.5	1	FT $\frac{w}{\text{their}(a)(iv)}$ if <i>their</i> (a)(iv) $\neq 1$ and dep on (a)(ii)
10(b)	Correct region shaded	4	B1 for arc 6 cm from E B1 for angle bisector of EAF B1 for perpendicular bisector of AF After B2 , SC1 for ‘correct’ region shaded provided only slight inaccuracy with the other line/curve
11(a)(i)	$55 \leq t < 60$	1	
11(a)(ii)	60.8 nfw	3	M2 for $\frac{\sum \text{frequency} \times \text{midvalue}}{50}$ oe or M1 for $\sum ft$

Question	Answers	Marks	Part marks
11(a)(iii)	$\frac{23}{50}$ or 0.46 or 46%	2	B1 for 23 seen or 16 + 7 seen
11(b)(i)	34	1	
11(b)(ii)	4.5	2	B1 for 31.5 to 32.5 <u>and</u> 36 to 37 seen
11(b)(iii)	(28, 0) (32, 15) (36, 45) (40, 60) plotted and points joined	3	B2 for at least 3 correct points plotted or B1 for 2 correct points plotted or (28, 0) (32, 15) (36, 45) and (40, 60) seen
12(a)	32.56 to 32.58 or 32.6	3	M2 for $\frac{72}{360} \times \pi \times 20 + 20$ oe or M1 for $\frac{72}{360} \times \pi \times 20$ A1 for 12.56 to 12.58 or 12.6 After 0 or 1, SC1 for <i>their</i> 'arc length' + 10 + 10 soi
12(b)(i)	62.83 to 62.84 or 62.8	2	M1 for $\frac{72}{360} \times \pi \times 10^2$
12(b)(ii)	4(.00) to 4.08 nfw	3	FT from <i>their</i> (b)(i) – (58.76 to 58.8) provided answer not negative M2 for <i>their</i> (b)(i) – $2 \times \frac{1}{2} \times 10 \times 10 \times \sin\left(\frac{72}{2}\right)$ oe or M1 for $[2 \times] \frac{1}{2} \times 10 \times 10 \times \sin\left(\frac{72}{2}\right)$ oe soi
12(c)	Add totals from (a) and (b) then divide by 2 Any half values are to be rounded down	4	



Cambridge Assessment International Education
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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2018

MARK SCHEME

Maximum Mark: 100

Published

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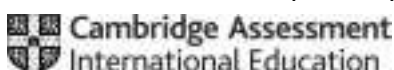
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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

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- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

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Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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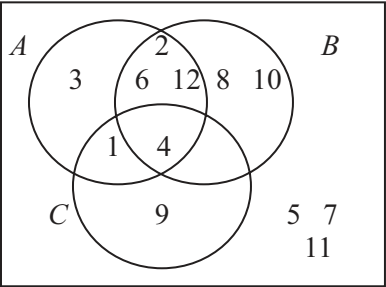
Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Abbreviations

cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
nfw	not from wrong working
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)	$(P \cup Q)'$ or $P' \cap Q'$	1	
1(b)(i)		2	B1 for 8 or more correct
1(b)(ii)	4	1	FT <i>their</i> Venn diagram provided no repeated elements
1(b)(iii)	1	1	FT <i>their</i> Venn diagram provided no repeated elements
1(b)(iv)	$A' \cap B \cap C$	1	
1(c)(i)	$2^2 \times 3^3 \times 5$	2	M1 for at least two correct stages in factor tree or ladder method
1(c)(ii)	$2 \times 3^2 \times 5$	2	B1 for 90 seen or $2^2 \times 3^4 \times 5^2$
2(a)	109.95 or 109.96	3	B2 for 2109.9(..) or 2110 or M2 for $2000 \left(1 + \frac{1.8}{100}\right)^3 - 2000$ oe or M1 for $2000 \left(1 + \frac{1.8}{100}\right)^3$ oe
2(b)	600	3	M1 for 54×12 (=648) or $\frac{54}{1.08}$ (=50) oe M1 for $\left(\frac{100+8}{100}\right)x = \text{their} 648$ oe soi or <i>their</i> 50×12
3(a)	9.5 oe	2	M1 for $4p - 2p = 7 + 12$ or better

Question	Answer	Marks	Partial Marks
3(b)	Correct method to eliminate one variable	M1	
	$x = 1, y = -3$	A2	A1 for $x = 1$ or $y = -3$ After A0 , SC1 for two correct values with no working or two values that satisfy one of the original equations
3(c)	$\frac{m}{2m-1}$ final answer nfw	3	B1 for $m(m+3)$ B1 for $(2m-1)(m+3)$
3(d)	62.5 oe	3	M2 for $b = \frac{4}{8} \times (5)^3$ oe soi or B1 for $\frac{4}{8}$ oe or $\left(\frac{5}{2}\right)^3$ oe soi or $b = ka^3$
4(a)	$\frac{1}{6}$ cao	1	
4(b)	$\frac{1}{660}$ oe	2	M1 for $\frac{1}{12} \times \frac{1}{11} \times \frac{2}{10}$ oe or SC1 for $\frac{1}{12} \times \frac{1}{12} \times \frac{2}{12}$ or answer $\frac{1}{864}$ or $\frac{1}{12}, \frac{1}{11}, \frac{2}{10}$
4(c)(i)	$\frac{8}{12}, \frac{8}{11}, \frac{4}{11}, \frac{7}{11}$ oe correctly placed	2	B1 for two correct
4(c)(ii)	$\frac{1}{11}$ oe	1	
4(c)(iii)	$\frac{16}{33}$ oe	2	M1 for $\frac{4}{12} \times \frac{8}{11}$ or $\frac{8}{12} \times \frac{4}{11}$ oe
5(a)(i)	$6n - 5$ oe	2	M1 for $6n + k$ oe with $k \neq 0$
5(a)(ii)	256 is not exactly divisible by 6 or 247 in sequence and next one is 253 oe	1	
5(b)(i)	$p^2 - 3$ oe	1	
5(b)(ii)	$p^2 + 2p + 4$ oe	1	
5(c)(i)	Correct drawing	1	
5(c)(ii)	28, 40	2	B1 for one correct
5(c)(iii)	$t^2 + 3t$ oe	2	B1 for $t^2 + \dots$
6(a)(i)	Correct construction with arcs	2	B1 for correct triangle with arcs missing or arc 6 cm from A or arc 9 cm from B

Question	Answer	Marks	Partial Marks
6(a)(ii)	77° to 81°	1	FT <i>their</i> angle BAC
6(b)	79875 cao	2	B1 for 225 and 355 seen
6(c)(i)	66° alternate [angles]	2	B1 for 66
6(c)(ii)	79°	1	FT 145 – <i>their</i> 66
6(c)(iii)	RQT RTQ	B1	
	QT is common oe	B1	
	AAS oe	B1	Dep on previous B1
7(a)	$15 + [2 \times] 3x + [2 \times] \left(\frac{15}{x} \times 3 \right)$	M1	
	Leading to $\left(15 + 6x + \frac{90}{x} \right)$ without error	A1	
7(b)	5.70 or 2.63 and $6x^2 - 50x + 90 [= 0]$ seen	4	B1 for $6x^2 - 50x + 90 [= 0]$ oe AND B2FT for $\frac{-(-50) \pm \sqrt{(-50)^2 - 4 \times 6 \times 90}}{2 \times 6}$ or B1FT for $\sqrt{(-50)^2 - 4 \times 6 \times 90}$ or $\frac{-(-50) \pm \sqrt{r}}{2 \times 6}$ After 0, SC2 for 5.70 or 2.63
7(c)(i)	74.25	1	
7(c)(ii)	Correct smooth curve	2	B1FT for at least 5 points correctly plotted
7(c)(iii)	6.5 to 6.6 2.3 to 2.4	2	FT <i>their</i> graph B1FT for either correct
8(a)	$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$	2	B1 for a correct row or column
8(b)	Triangle with vertices at (2, –3) (4, –3) (2, –4)	1	
8(c)	Reflection in $y = x$	2	B1 for reflection or $y = x$
8(d)	Rectangle with vertices at (–1, 5) (–1, 6) (2, 6) (2, 5)	2	B1 for R translated by $\begin{pmatrix} -2 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 3 \end{pmatrix}$

Question	Answer	Marks	Partial Marks
9(a)	9.025 to 9.03	4	M3 for $\frac{70}{360} \times \pi \times 8^2 - \frac{1}{2} \times 8^2 \times \sin 70$ or M1 for $\frac{70}{360} \times \pi \times 8^2$ M1 for $\frac{1}{2} \times 8^2 \times \sin 70$
9(b)(i)	$8 - 8\cos 35$ oe	M2	M1 for $8\cos 35$ (= 6.55..)
	1.45 or 1.446 to 1.447 so yes	A1	
9(b)(ii)	192	2	B1 for two of 4, 16 and 3 soi or M1 for $\frac{48 \times 4x \times 24}{16 \times x \times 1.5}$ oe
10(a)	11 13	2	M1 for $\frac{12}{15}[\times 60]$ oe
10(b)	13.7 or 13.70...	4	B1 for 146° AND M2 for $\sqrt{12^2 + 2^2 - 2 \times 12 \times 2 \times \cos 146}$ or M1 for $12^2 + 2^2 - 2 \times 12 \times 2 \times \cos 146$ <i>Alternative</i> B1 for 9.95 or 9.948 to 9.949 or 6.71[0...] AND M2 for $\sqrt{their 6.71^2 + (their 9.94 + 2)^2}$ or M1 for $their 6.71^2 + (their 9.94 + 2)^2$
10(c)	3.0 or 3.00 to 3.01	2	M1 for $\tan .. = \frac{\text{figs}105}{\text{figs}2}$ oe
11(a)	Correct region indicated	3	B1 for ruled line $x = 1$ B1 for ruled line $x + y = 5$
11(b)(i)	6.32...	2	M1 for $\sqrt{(5 - -1)^2 + (5 - 3)^2}$
11(b)(ii)	$y = -3x + 10$ oe	4	B3 for (2, 4) and $y = -3x + c$ OR B2 for $y = -3x + c$ OR B1 for (2, 4) or $\frac{5-3}{5-(-1)}$ oe and M1 for $-\frac{1}{their \frac{1}{3}}$



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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

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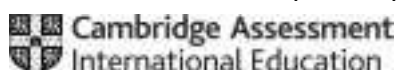
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FT	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
nfw	not from wrong working
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)	17.6[0]	2	B1 for 7 (hours) 45 (minutes) or 7.75 (hours) or M1 for $682 \div (5 \times \text{their } 7.75)$ oe
1(b)	275	2	M1 for $\frac{(100-16)}{100}x = 231$ oe or SC1 for answer 44
1(c)	259[.00] cao	3	M2 for $\frac{850 \times 0.44 - 260}{0.44}$ oe or M1 for 850×0.44 or $260 \div 0.44$ or $(\text{their } 374 - 260) \div 0.44$
1(d)	Account B, \$3118.53 and 3112.37 or 1.037[...] seen	4	M1 for $[3000 \times] 1.011 \times 1.012 \times 1.014$ oe M1 for $[3000 \times] 1.013^3$ oe A1 for 3112.37 or 3118.53 or 1.037[...] or 1.0395[...]
2(a)	Correct frequency polygon (ruled lines)	2	B1 for 4 or 5 heights correct soi
2(b)	$q = 9$	B2	M1 for $[0 \times p] + 1 \times 14 + 2 \times 15 + 3 \times 7 + 4 \times q + 5 \times 5 + 6 \times 2$ oe
	$p = 17 - \text{their } q$	B1	Strict FT provided q integer with $0 \leq q \leq 17$
2(c)(i)	Correct labelled pie chart: C[omedy] , D[rama] , H[orror]	3	B2 for correct sectors without labels or incorrect labels or B1 for one correct sector or 90, 54 and 72 seen
2(c)(ii)	$\frac{21}{60}, \frac{7}{20}, \frac{126}{360}, 0.35$ or 35%	1	
2(c)(iii)	$\frac{210}{3540}$ oe	2	M1 for $\frac{15}{60} \times \frac{14}{59} [\times 2]$ or SC1 for $\left(\frac{15}{60}\right)^2$ or answer $\frac{1}{16}$ oe
3(a)	$x = -1.8$ oe	2	M1 for $3x + 7x = 12 - 30$ or $-7x - 3x = 30 - 12$ or better

Question	Answer	Marks	Partial Marks
3(b)	Correct method to eliminate one variable	M1	
	$x = 2.5$ oe $y = -6$	A2	A1 for either $x = 2.5$ or $y = -6$ After A0 , SC1 for a pair of values that satisfy either equation or for correct answers with no working
3(c)	$\frac{v}{2v+3}$ final answer nfw	3	B1 for $v(v-8)$ seen B1 for $(2v+3)(v-8)$ seen
4(a)(i)	Correctly completed Venn diagram	1	
4(a)(ii)	36	1	
4(a)(iii)	13	1	FT $n(A \cup B)$ from <i>their</i> Venn diagram provided no repeated elements in sets A and B
4(a)(iv)	1, 4, 6, 9, 12, 18	1	FT provided no repeated elements in sets A and B
4(b)	1540	2	B1 for answer $1540k$, where k is an integer or for $2 \times 2 \times 5 \times 7$ and $2 \times 5 \times 7 \times 11$ seen or 2, 2, 5, 7, 11
4(c)	18	2	B1 for answer 2, 3, 6 or 9 or for $2 \times 3 \times 3 \times 5 \times 5$ and $2 \times 3 \times 3 \times 17$ seen or 2, 3, 3 with 25 and 17
5(a)(i)	25.7 or 25.72 to 25.73	2	M1 for $\frac{134}{360} \times 2 \times \pi \times 11$ oe
5(a)(ii)	4.3[0] or 4.298...	2	M1 for $\cos\left(\frac{134}{2}\right) = \frac{d}{11}$ or $\sin\left(\frac{180-134}{2}\right) = \frac{d}{11}$ oe
5(b)(i)	$\frac{1}{3}\pi r^2 \times 9.5 = 115$ or $r^2 = \frac{3V}{\pi h}$ or better	M1	Correct substitution into volume equation or correct rearrangement
	$r = 3.39[9\dots]$ or $3.40[00]$	A1	
5(b)(ii)	108 or 107.7 to 107.8	3	M2 for $\pi \times 3.4 \times \sqrt{9.5^2 + 3.4^2}$ or M1 for $l^2 = 9.5^2 + 3.4^2$ soi

Question	Answer	Marks	Partial Marks
6(a)	5.5, 5.5 oe	1	Both correct
6(b)	Correct smooth curve	3	B2FT for 8 or 9 points correctly plotted or B1FT for 6 or 7 points correctly plotted
6(c)	tangent drawn at $x = 1.5$	B1	Dependent on a curve drawn between $x = 1$ and $x = 2$
	-1.7 to -1.3	B1	
6(d)	$x \leq 0.6$ to 0.9 $x \geq 5.1$ to 5.4	2	B1 for one correct or SC1 for answers reversed
6(e)(i)	Ruled line passing through (0, 3) and (4, 0) crossing curve twice	2	B1 for short or unruled line or for two correct points plotted
6(e)(ii)	$A = -9, B = -4$	2	B1 for either correct or $2x^2 - 9x - 4 [=0]$ or M1 for $\left(\frac{x^2}{2} - 3x + 2\right) = \frac{12 - 3x}{4}$ oe After 0, SC1 for $A = -9.2$ to -8.8 <u>and</u> $B = -4.2$ to -3.8
7(a)	$\sin CAB = \frac{3.7 \sin 42}{2.8}$ OR $\hat{CAB} = \sin^{-1}\left(\frac{3.7 \sin 42}{2.8}\right)$ OR $\frac{\sin CAB}{3.7} = \frac{\sin 42}{2.8}$ and $\sin = 0.88[42\dots]$	M2	M1 for $\frac{3.7}{\sin CAB} = \frac{2.8}{\sin 42}$ oe
	$\hat{CAB} = 62.15[4\dots]$	A1	
7(b)	$[0]17.2^\circ$	2	M1 for $135 + 62.2 - 180$ oe

Question	Answer	Marks	Partial Marks
7(c)	10.5 to 10.6	4	B3 for 4.05 to 4.06 OR M2 for $\sqrt{2.8^2 + 3.7^2 - 2 \times 2.8 \times 3.7 \times \cos(180 - 42 - 62.2)}$ oe or M1 for $2.8^2 + 3.7^2 - 2 \times 2.8 \times 3.7 \times \cos(180 - 42 - 62.2)$ oe OR M2 for $\frac{2.8 \sin(180 - 42 - 62.2)}{\sin 42}$ oe or M1 for $\frac{\sin(180 - 42 - 62.2)}{AB} = \frac{\sin 42}{2.8}$ oe OR M2 for $\frac{3.7 \sin(180 - 42 - 62.2)}{\sin 62.2}$ oe or M1 for $\frac{\sin(180 - 42 - 62.2)}{AB} = \frac{\sin 62.2}{3.7}$ oe OR B1 for $\hat{ACB} = 75.8$
8(a)	$\angle BAX = \angle OCX$, alternate [angles] $\angle ABX = \angle COX$, alternate [angles] $\angle AXB = \angle CXO$, [vertically] opposite	3	B1 for two correct pairs of angles B1 for correct reason for one pair of angles
8(b)(i)	4c	1	
8(b)(ii)	9a – 6c or 3(3a – 2c)	2	B1 for answer 9a + kc or ka – 6c ($k \neq 0$)
8(c)(i)	3 : 2	2	B1 for 3k : 2k, where k is an integer
8(c)(ii)	9 : 4	1	FT their 3 ² : their 2 ²
8(c)(iii)	4 : 5	1	
9(a)(i)	$\frac{12 \times 60}{x}$ oe	1	
9(a)(ii)	$\frac{8 \times 60}{x - 1.5}$ oe	1	After 0 in (i) and (ii), SC1 for $\frac{8}{x - 1.5}$ and (a)(i) $\frac{12}{x}$

Question	Answer	Marks	Partial Marks
9(a)(iii)	$\frac{720}{x} + \frac{480}{x-1.5} = 110$ oe	M1	FT <i>their</i> (a)(i) and (a)(ii) if functions of x
	$\frac{720(x-1.5) + 480x}{x(x-1.5)} = 110$ or $720(x-1.5) + 480x = 110x(x-1.5)$	M1	Dep on equation of form $\frac{c}{px} + \frac{d}{qx+r} = e$ where p, q, r, c, d and e are numeric and non zero, AND either correctly uses a common denominator for <i>their</i> fractions or correctly removes <i>their</i> fractions
	$720x - 1080 + 480x = 110x^2 - 165x$	A1	Correct elimination of correct brackets
	With a minimum of one intermediate step establishes $22x^2 - 273x + 216 = 0$	A1	
9(a)(iv)	$\frac{-(-273) \pm \sqrt{(-273)^2 - 4 \times 22 \times 216}}{2 \times 22}$ or $\frac{273}{44} \pm \sqrt{\left(\frac{273}{44}\right)^2 - \left(\frac{216}{22}\right)}$	B2	B1 for $\sqrt{(-273)^2 - 4 \times 22 \times 216}$ or for $\frac{-(-273) \pm \sqrt{\text{their} 55521}}{2 \times 22}$ or for $\left(x - \frac{273}{44}\right)^2$
	11.56 and 0.85 cao	B1	
9(b)	1 hour 59 minutes cao	3	M2 for $\frac{20}{\text{their} 11.56 - 1.5} [\times 60]$ oe or M1 for <i>their</i> $11.56 - 1.5$ or for $\frac{20}{\text{their } x}$
10(a)	$\left(-1, \frac{1}{2}\right)$ or $(-1, 0.5)$ cao	1	
10(b)	$\frac{1}{2}$ oe	1	

Question	Answer	Marks	Partial Marks
10(c)	$[\text{Gradient of } BC =] \frac{-8}{4}$	M1	<u>Alternative 1:</u> M1 for $\frac{1}{2} \times m_{BC} = -1$ or $m_{BC} = -\frac{1}{0.5}$ oe leading to $m_{BC} = -2$
	$\frac{1}{2} \times \frac{-8}{4} = -1$ hence perpendicular	A1	A1 for gradient of $BC = \frac{-8}{4} = -2$ hence perpendicular <u>Alternative 2:</u> M1 for $\overrightarrow{AB} = \begin{pmatrix} 6 \\ 3 \end{pmatrix}$ oe and $\overrightarrow{AC} = \begin{pmatrix} 10 \\ -5 \end{pmatrix}$ oe A1 for $(4^2 + 8^2) + (6^2 + 3^2) = (10^2 + 5^2)$ hence perpendicular
10(d)	$(0, -9)$	2	B1 for one value correct or M1 for $\begin{pmatrix} -4 \\ -1 \end{pmatrix} + \begin{pmatrix} 4 \\ -8 \end{pmatrix}$ oe or $\begin{pmatrix} 6 \\ -6 \end{pmatrix} + \begin{pmatrix} -6 \\ -3 \end{pmatrix}$ oe
10(e)	31.3 or 31.30...	4	M3 for $[2 \times] \left(\sqrt{3^2 + 6^2} + \sqrt{4^2 + (-8)^2} \right)$ oe or M2 for $\sqrt{4^2 + (-8)^2}$ oe or $\sqrt{3^2 + 6^2}$ oe or M1 for $4^2 + (-8)^2$ oe or $3^2 + 6^2$ oe



MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2019

MARK SCHEME

Maximum Mark: 100

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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Cambridge International is publishing the mark schemes for the May/June 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **7** printed pages.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Abbreviations

cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
nfw	not from wrong working
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)	21 600	1	
1(b)(i)	34.4 or 34.44 to 34.45	3	M2 for $\frac{1800 - \text{their}1180}{1800}$ $[\times 100]$ oe or $\frac{\text{their}1180}{1800} \times 100$ or M1 for $\frac{\text{their}1180}{1800} [\times 100]$ oe or B1 for 620
1(b)(ii)	518	2	M1 for 500×1.036 oe
1(c)	2400	2	M1 for $\frac{100 - 25}{100}x = 1800$ soi
2(a)	(14.7, 32.5) (13.7, 28.4) (12.9, 26.1) (15.2, 33.5) (16.1, 36.0) plotted	2	B1 for 3 or 4 correct
2(b)	positive	1	
2(c)	Ruled line of best fit	1	
2(d)	Strict FT <i>their</i> ruled line of best fit	1	
3(a)(i)	64	B1	
	<i>QBC</i> alternate to angle <i>BCA</i> oe	B1	
	<i>ABC</i> is isosceles triangle or angle sum of triangle [=180]	B1	
3(a)(ii)	75	1	
3(b)	117	3	B2 for [interior angles] 108 and 135 soi or [exterior angles] 72 and 45 soi or B1 for [interior angle] 108 or 135 soi or [exterior angle] 72 or 45 soi

Question	Answer	Marks	Partial Marks
4(a)(i)	$\frac{3}{25y}$ final answer	2	B1 for $\frac{3}{25y}$ seen or $\frac{42y}{350y^2}$ or better
4(a)(ii)	$\frac{k+4}{k+2}$ final answer	3	B1 for $(k+4)(k-4)$ B1 for $(k-4)(k+2)$
4(b)	$\frac{14}{3}$ or $4\frac{2}{3}$ or 4.67 or 4.666 to 4.667	2	M1 for $3x - 12 = 7 - 5$ or $x - 4 = \frac{7-5}{3}$
4(c)	$\frac{-5 \pm \sqrt{5^2 - 4 \times 3 \times (-4)}}{2 \times 3}$ oe	B2	B1 for $\sqrt{5^2 - 4 \times 3 \times -4}$ oe or $\frac{-5 \pm \sqrt{r}}{2 \times 3}$ oe
	0.59 and -2.26	B1	
5(a)(i)	Correct parallelogram with construction arcs at <i>B</i> and <i>C</i>	3	B2 for correct parallelogram without arcs or B1 for two of $AB = 8$ or $DC = 8$ or $BD = 11$ or $BC = 6$
5(a)(ii)	101 to 105	1	FT <i>their</i> triangle <i>ABD</i>
5(a)(iii)	4[.0] to 4.4 with <i>AE</i> drawn	1	FT <i>their</i> <i>AE</i> from correct parallelogram
5(b)(i)	7.95 or 7.948 to 7.949	2	M1 for $\cos 58 = \frac{PS}{15}$ oe
5(b)(ii)	133.7 or 133.72 to 133.73	4	B1 for 32 and M2 for $\sin R = \frac{15 \times \sin \text{their } 32}{11}$ or M1 for $\frac{15}{\sin R} = \frac{11}{\sin \text{their } 32}$ oe

Question	Answer	Marks	Partial Marks
6(a)(i)	$\frac{7}{3} < x \leq 7$ oe final answer	3	B2 for $\frac{7}{3} < x \leq 7$ seen or final answer $\frac{7}{3} < x$ or final answer $x \leq 7$ B1 for either correct inequality seen or M1 for $\frac{10}{3} [\dots] x + 1 [\dots]$ $\frac{24}{3}$ or $10 - 3 [\dots] 3x [\dots] 24 - 3$ soi
6(a)(ii)	5	1	
6(b)	$y \geq 0$ $x \geq y$ oe $2x + y \leq 6$ oe	3	B1 for each inequality If 0 scored, SC1 for 3 correct equations soi
7(a)	23	1	
7(b)	$3x - 4$ final answer	2	B1 for $3y = x + 4$ or $y - \frac{4}{3} = \frac{x}{3}$ or $3y - 4$ or $x = \frac{y + 4}{3}$
7(c)	$\frac{19}{14}$ or $1\frac{5}{14}$ or 1.36 or 1.357 to 1.358	3	B2 for answer $14p = k$ or $kp = 19$ or M1 for $5p - 7 = \frac{p + 4}{3} - 2$
7(d)	$a = \frac{5}{3}$ oe $b = -1$	3	B2 for either correct or M1 for $\frac{5x - 7 + 4}{3}$
8(a)	$\frac{22}{80}$ or $\frac{11}{40}$ oe	1	
8(b)	33.875 or 33.9 nfw	3	B1 for correct use of midpoints M1 for $\frac{\sum fx}{80}$
8(c)	Correct cumulative frequency diagram	3	B2 for at least 5 correct points plotted or B1 for 6, 22, 47, 65, 78, 80 soi

Question	Answer	Marks	Partial Marks
8(d)(i)	32.5 to 34	1	FT <i>their</i> cumulative frequency diagram
8(d)(ii)	8 to 9.5	2	FT <i>their</i> cumulative frequency diagram M1 for [LQ] 29 to 30 nfwf or [UQ] 38 to 39 nfwf
8(e)	6, 7 or 8	2	M1 for attempt to read at 43
9(a)(i)(a)	$\frac{3}{2}(\mathbf{p} + 2\mathbf{q})$ oe simplified expression	1	
9(a)(i)(b)	$\frac{5}{2}\mathbf{p}$ or $2\frac{1}{2}\mathbf{p}$ or $2.5\mathbf{p}$	2	M1 for a correct vector route
9(a)(ii)	Trapezium	B1	
	$\overrightarrow{PQ}$ is a multiple of $\overrightarrow{SR}$ or PQ is parallel to SR since $\overrightarrow{PQ}=4\mathbf{p}$ and $\overrightarrow{SR}=2.5\mathbf{p}$ oe	B1	
9(a)(iii)	8 : 5	2	FT <i>their</i> $\overrightarrow{SR}$ of form $k\mathbf{p}$ B1 for 4 : 2.5 oe
9(b)(i)	$\begin{pmatrix} 2 \\ -3 \end{pmatrix}$ final answer	1	
9(b)(ii)	6.32 or 6.324 to 6.325	2	M1 for $6^2 + (-2)^2$
9(b)(iii)	$\begin{pmatrix} 6 \\ 1 \end{pmatrix}$ final answer	2	B1 for $\begin{pmatrix} 3 \\ -1 \end{pmatrix}$
10(a)	$\frac{1}{2}(8-x)x \times \frac{1}{2} \times 20$	M2	M1 for $\frac{1}{2}(8-x)x \times \sin 30$ isw
	$(40x - 5x^2)$ nfwf	A1	
10(b)	Curve through (1, 35) (2, 60) (3, 75) (4, 80) (5, 75) (6, 60) (7, 35)	3	B2 for 3 or 4 more correct points plotted or B1 for at least 2 more correct points soi
10(c)	1.5 to 1.6 and 6.4 to 6.5	2	B1 for either
10(d)	$V = 12x$ ruled	M2	M1 for $V = 4 \times 3 \times x$ soi
	5.5 to 5.6	B1	

Question	Answer	Marks	Partial Marks
11(a)	128[.0]° or 128.03° to 128.04°	4	B3 for 66[.0] or 66.03 to 66.04 or M2 for $[\cos L] = \frac{14^2 + 8^2 - 13^2}{2 \times 14 \times 8}$ or M1 for $13^2 = 14^2 + 8^2 - 2 \times 14 \times 8 \times \cos L$ After 0 scored, SC1 for 62 + <i>their</i> $\hat{B\hat{L}A}$
11(b)	6.93 or 6.92	2	M1 for $13^2 - 11^2$ isw
11(c)	3 hours 28 minutes	2	M1 for $\frac{13}{3.75}$



MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2019

MARK SCHEME

Maximum Mark: 100

Published

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GENERIC MARKING PRINCIPLE 4:

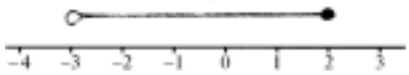
Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks	Partial Marks
1(a)	83[.00]	1	
1(b)(i)	15	2	M1 for $\frac{26 - 22.10}{26} [\times 100]$ oe or $\frac{22.10}{26} \times 100$ oe After 0, SC1 for answer 85
1(b)(ii)	9.4[0] or 9.397 to 9.398	3	M1 for [Total cost =] $22.10 \times 2 + 15.50 \times 2$ oe or [Total reduction =] $2 \times (26.00 - 22.10)$ oe M1 for $\frac{\text{their}83 - \text{their}75.2}{\text{their}83} [\times 100]$ oe or $\frac{\text{their}75.2}{\text{their}83} \times 100$ oe or for answer 90.6[0...]
1(c)(i)	5 (hours) 35 (minutes) cao	1	
1(c)(ii)	140	2	B1 for 4 [shows] soi
2(a)	(16, 23) (18,18) (20, 12) (21, 8) plotted	2	B1 for 2 or 3 correct plots
2(b)	negative	1	
2(c)	Ruled line of best fit	1	
2(d)	Strict FT <i>their</i> ruled line of best fit read at Sydney = 15°C	1	
3(a)		1	
3(b)	$y \geq 0$ $x \leq 4$ oe $y \leq \frac{1}{2}x$ oe	3	B1 for each inequality After 0, SC1 for 3 correct equations soi
3(c)	$-1 \leq m < 4.5$ final answer	3	B2 for $-1 \leq m < 4.5$ seen or final answer $-1 \leq m$ or final answer $m < 4.5$ or M1 for $-\frac{12}{4} [\dots] m - 2 [\dots] \frac{10}{4}$ or $-12 + 8 [\dots] 4m [\dots] 10 + 8$

Question	Answer	Marks	Partial Marks
4(a)(i)	All angles and complete reasons eg $\hat{AEB} = 110$ corresponding angle $\hat{ABE} = 35$ isosceles triangle $[x =] 145$ [straight] line OR $\hat{AEB} = 110$ corresponding angle $\hat{ABE} = 180 - x$ [straight] line $110 + (180 - x) + (180 - x) = 180$ isosceles triangle $[x =] 145$	3	B1FT for one angle with its reason stated B1 for $[x =] 145$ Alternative example: $\hat{DEB} = 70$ interior angles (or allied) $\hat{AEB} = 110$ [straight] line $\hat{ABE} = 35$ isosceles triangle $[x =] 145$ [straight] line
4(a)(ii)	8 cao	1	
4(b)	55°	2	B1 for 540 or M1 for $a + 3a + 130 + 80 + 110 = 180k$ where $k \geq 2$ and an integer
4(c)	$\cos [P\hat{Q}M] = \frac{7}{14}$ or $\sin [Q\hat{P}M] = \frac{7}{14}$	M1	
	$[P\hat{Q}R =] 120$ or $P\hat{Q}M = M\hat{Q}R = 60$ or $Q\hat{P}M = Q\hat{R}M = 30$	A2	A1 for $P\hat{Q}M = 60$ or $M\hat{Q}R = 60$ or $Q\hat{P}M = 30$ or $Q\hat{R}M = 30$
	6	A1	Dep on $P\hat{Q}R$ exactly 120 soi or exterior angle is exactly 60 soi
5(a)(i)	$\frac{7a}{12b}$ final answer	2	M1 for $\frac{9a}{12b} - \frac{2a}{12b}$ or a correct method to a single fraction eg $\frac{18ab - 4ab}{(4b)(6b)}$
5(a)(ii)	$\frac{b+3}{3}$ final answer nfw	2	B1 for $(b-3)(b+3)$ seen or final answer $\frac{2(b+3)}{6}$ or $\frac{2b+6}{6}$
5(b)	-2.375 or $-2\frac{3}{8}$ or $-\frac{19}{8}$	2	M1 for $3x = 1 - 5x - 20$ leading to $3x + 5x = 1 - 20$ or $3x + 5x = 1 - 20$ as first line of working

Question	Answer	Marks	Partial Marks
5(c)	$2y(y+3) - y \times y [= 55]$ oe	M1	
	$y^2 + 6y - 55 [= 0]$	A1	
	$(y-5)(y+11) [=0]$ or $[y =] \frac{-6 \pm \sqrt{6^2 - 4 \times 1 \times -55}}{2 \times 1}$	M1	Correct factorisation of <i>their</i> three-term quadratic [=0] or correct substitution into quadratic formula
	$y = 5$ [$y = -11$]	B1	
	10 by 8	B1	FT <i>their</i> positive y value into $2y$ by $y + 3$
6(a)	80 000	2	B1 for answer figs 8 or 400 000 seen or figs5 : figs4 seen
6(b)	235 to 240	1	
6(c)	Correct position of C	2	B1 for bearing of 120° from A or 195° from B
6(d)	2.56 to 2.96	2	Dep on 2 marks in (c) B1FT for correct measurement of <i>their</i> AC
6(e)(i)	38.8 or 38.78 to 38.79	3	M2 for $\sin[\dots] = \frac{4 \sin 70}{6}$ or $\sin^{-1}\left(\frac{4 \sin 70}{6}\right)$ or M1 for $\frac{4}{\sin[\dots]} = \frac{6}{\sin 70}$ oe
6(e)(ii)	29.2 or 29.18 to 29.19	3	M2 for $\frac{6}{12\frac{1}{3}} \times 60$ oe or M1 for $\frac{6}{\text{their time}}$ or $\frac{6000}{\text{their time}}$
7(a)	1.25 oe	1	
7(b)	Correct smooth curve	2	B1FT for at least 6 points correctly plotted
7(c)	$y = -\frac{1}{5}x + 2.4$ oe final answer	3	M1 for $\frac{d-b}{c-a}$ from correct (a, b) and (c, d) M1 for correct method to find y intercept

Question	Answer	Marks	Partial Marks
7(d)	line drawn through (1, 3) with negative gradient, crossing the curve twice	B1	
	5.8 to 6.2	B1	
8(a)	$\frac{23}{75}$ oe	1	
8(b)	192 or 192.4 to 192.5 nfw	3	M1 for $4 \times 165, 10 \times 175, 15 \times 185, 23 \times 195, 18 \times 205$ and 5×215 M1 for $(4 \times 165 + 10 \times 175 + 15 \times 185 + 23 \times 195 + 18 \times 205 + 5 \times 215) \div 75$ oe After 0 scored, SC1 for $\sum fx \div 75$
8(c)	Correct cumulative frequency curve	3	B2 for at least 5 points plotted correctly or B1 for 4, 14, 29, 52, 70, 75 soi
8(d)	193 to 195	1	Dep on no clear indication of incorrect CF
8(e)	202 to 205	2	FT <i>their</i> increasing curve B1 for 60 nfw
8(f)	11 or 12 cao	1	
9(a)	6.84 or 6.839 to 6.84[0]	3	B2 for 46.7 to 46.8 or M1 for $15^2 + 14^2 - 2 \times 14 \times 15 \times \cos 27$
9(b)	21[.0] or 20.97 to 20.98	3	M2 for $\frac{1000}{\frac{1}{2} \times 14 \times 15 \times \sin 27}$ oe or M1 for $\frac{1}{2} \times 14 \times 15 \times \sin 27$ oe isw
9(c)	6.36 or 6.355 to 6.356	2	M1 for $\sin 27 = \frac{h}{14}$ oe
10(a)(i)	$\begin{pmatrix} -7 \\ 1 \end{pmatrix}$ final answer	1	

Question	Answer	Marks	Partial Marks
10(a)(ii)	$4^2 + (\pm 3)^2$	M1	
	$1^2 + (\pm 5)^2$	M1	
	Correct concluding statement eg $\sqrt{25} < \sqrt{26}$ or $5 > 5.1[0]$ wrong or $ f = 5$ $ g = 5.099$ so $ f $ is not greater than $ g $	A1	
10(b)(i)	$-\frac{1}{3}\mathbf{a} + \mathbf{b}$ or $\frac{1}{3}(-\mathbf{a} + 3\mathbf{b})$	1	
10(b)(ii)	$\frac{1}{6}\mathbf{a} + \frac{1}{2}\mathbf{b}$ or $\frac{1}{6}(\mathbf{a} + 3\mathbf{b})$	2	M1FT for a correct vector route for $\overrightarrow{OQ}$
10(b)(iii)	$\left[\overrightarrow{AR}\right] = -\frac{1}{2}\mathbf{a} + \frac{3}{2}\mathbf{b}$ or $\frac{1}{2}(-\mathbf{a} + 3\mathbf{b})$ or $-\frac{1}{2}(\mathbf{a} - 3\mathbf{b})$	B2	M1 for $-\mathbf{a} + 3 \times \text{their (b)(ii)}$ or $-\frac{2}{3}\mathbf{a} + \frac{1}{2}\text{their(b)(i)} + 2 \times \text{their (b)(ii)}$
	$OQ = \frac{1}{3}OR$, $OP = \frac{1}{3}OA$ and $P\hat{O}R = A\hat{O}R$		M1 for <u>two</u> of $OQ = \frac{1}{3}OR$, $OP = \frac{1}{3}OA$ or $P\hat{O}R = A\hat{O}R$
	$\overrightarrow{AR} = \frac{3}{2}\overrightarrow{PB}$ oe	B1	Dep on B2
	Similar triangles $O\hat{P}Q = O\hat{A}R$ or Similar triangles $O\hat{Q}P = O\hat{R}A$		Dep on B2
11(a)	2.5 oe	1	
11(b)	$\frac{4x+4}{7}$ oe	2	B1 for $\frac{7x}{4} = y + 1$ or $7x - 4 = 4y$ or $\frac{x}{4} - \frac{1}{7} = \frac{y}{7}$ or $x = \frac{7y}{4} - 1$ or better
11(c)	4	2	B1 for $3(t - 2) = 6$ oe
11(d)	$p = \frac{21}{4}$ oe $q = -9$	3	B2 for $p = \frac{21}{4}$ oe or $q = -9$ or B1 for $3\left(\frac{7x}{4} - 1 - 2\right)$ oe



Cambridge O Level

MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2020

MARK SCHEME

Maximum Mark: 100

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

This document consists of **8** printed pages.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Mathematics Specific Marking Principles	
1	Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.
2	Unless specified in the question, answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected.
3	Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points.
4	Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).
5	Where a candidate has misread a number in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 mark for the misread.
6	Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

Abbreviations

cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
nfw	not from wrong working
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)	54.1 or 54.12 to 54.13 nfw	3	B1 for use of correct midpoints M1 for $\frac{35 \times 10 + 45 \times 18 + 55 \times 27 + 65 \times 19 + 75 \times 6}{80}$
1(b)	Correct cumulative frequency curve	3	B2 for 4 or 5 correct points plotted or B1 for correct cumulative frequencies soi
1(c)(i)	53 to 55	1	FT <i>their</i> CF diagram
1(c)(ii)	14 to 18	2	FT <i>their</i> CF diagram B1 for [LQ =] 45 to 47 or [UQ =] 61 to 63
2(a)	Reflection <i>x</i> -axis oe	2	B1 for either
2(b)	Correct rotation, vertices (1, 1) (1, 4) (0, 2)	2	B1 for correct size and orientation, incorrect position After 0 scored, SC1 for 90° clockwise rotation about (1, 1)
2(c)	Enlargement, scale factor 2, centre (0, 0)	3	B1 for each After 0 scored, SC1 for correct enlargement, vertices (2, 2) (8, 2) (4, 4)
3(a)	$[n =] \frac{m+3}{4}$ oe	2	M1 for correct first step
3(b)	Correct method to eliminate one variable	M1	
	$x = 0.4$ oe , $y = -1$	A2	A1 for either $x = 0.4$ oe or $y = -1$ After A0, SC1 for a pair of values that satisfy either equation or for correct answers with no working

Question	Answer	Marks	Partial Marks
3(c)	$\frac{-3 \pm \sqrt{3^2 - 4 \times 5 \times -1}}{2 \times 5}$	B2	B1 for $\sqrt{3^2 - 4 \times 5 \times -1}$ or for $\frac{-3 \pm \sqrt{p}}{2 \times 5}$
	0.24, -0.84	B1	
4(a)	2590 or 2588 to 2589	3	M2 for $6000 \left(1 + \frac{2.5}{100}\right)^5$ or M1 for $6000 \left(1 + \frac{2.5}{100}\right)^n$ where $n > 1$ After 0, SC1 for answer 2550
4(b)	85 cao	3	M2 for $\frac{800 \times 3.16 - 2250}{3.27}$ or M1 for 800×3.16 or answer from $\frac{x}{3.27}$
4(c)	2.15	3	M2 for $\sqrt[3]{\frac{1598.85}{1500}}$ or M1 for $1500 k^3 = 1598.85$ oe
5(a)	$\sqrt{7.5^2 - 6^2} = 4.5$	2	M1 for $6^2 + x^2 = 7.5^2$ oe
5(b)(i)	18	3	M2 for $4.5 \left(\frac{80}{2 \times \frac{30}{6} \times \frac{28}{14}} \right)$ oe or M1 for $2 \times \frac{30}{6} \times \frac{28}{14} \times h = 80$ oe After 0 scored, SC1 for answer 36
5(b)(ii)	468 cao	2	M1 for $\frac{37500}{80}$
5(c)(i)	0.5[0]	2	M1 for $\frac{100 + 40}{100} x = 0.70$ oe

Question	Answer	Marks	Partial Marks
5(c)(ii)	26	5	M1 for $\frac{3}{5} \times 80$ M1 for $0.70 \times \frac{100 + 30}{100}$ oe M1 for $(80 - \text{their}48) \times 0.84$ M1 for $\frac{\text{their}70.56 - 80 \times 0.7}{80 \times 0.7}$ oe or $\frac{70.56}{80 \times 0.7} \times 100$
6(a)(i)	4.75 oe	1	
6(a)(ii)	Correct curve	3	B2FT for 6 or 7 points correctly plotted or B1FT for 4 or 5 points correctly plotted
6(a)(iii)(a)	Ruled line through (0, 1), gradient 1/3	2	B1 for ‘correct’ freehand line or ruled line with positive gradient through (0, 1) or ruled line with gradient 1/3
6(a)(iii)(b)	-2.5 to -2.1, 0, 2.1 to 2.5	2	B1 for two correct
6(a)(iii)(c)	$A = 3, B = 16$	2	B1 for either correct or $\frac{1}{3}x + 1 = \frac{x^3}{4} - x + 1$ or better
6(b)	$y = 2x^2$ $y = 2x^2 - 2$ $y = x^2 - 2x$	2	B1 for one correct
7(a)	$3x + 103 + x + 20 + 45 = 360$ oe	M2	M1 for $3x + 103 + x + 20 + \text{their}45 = 360$ or B1 for [exterior of octagon =] 45
	48	B1	
7(b)(i)	[$\hat{PQT}$ =] 58	B1	
	$\hat{PTQ} = 32$ angles in same segment $\hat{TPQ} = 90$ angles in semi-circle $\hat{PQT} = 58$ angles in triangle	B2	B1 for two reasons Alternative: $\hat{TSQ} = 90$ angles in a semi-circle $\hat{SP} = 58$ $\hat{QTP} = 58$ angles in same segment
7(b)(ii)	116	2	B1 for $\hat{SQR} = 32$ or $\hat{QSR} = 32$
7(b)(iii)	26	1	

Question	Answer	Marks	Partial Marks
8(a)(i)	154 or 153.5 to 153.6	2	M1 for $\frac{110}{360} \times 2 \times \pi \times 80$
8(a)(ii)	4199 to 4200...	3	M2 for $\frac{110}{360} \times \pi \times (80^2 - 45^2)$ oe or M1 for $\frac{110}{360} \times \pi \times 80^2$ or $\frac{110}{360} \times \pi \times 45^2$
8(b)	671.8 to 672.0...	2	FT <i>their</i> a(ii) $\times 0.16$ B1 for $\left(\frac{80}{32}\right)^2$ oe or $\left(\frac{32}{80}\right)^2$ oe
9(a)	$\frac{4}{9}, \frac{x}{9}$	2	B1 for 1 correct
9(b)	$\frac{12}{90}$ oe	1	
9(c)(i)	$\frac{4}{10} \times \frac{3}{9} + \frac{x}{10} \times \frac{x-1}{9} + \frac{6-x}{10} \times \frac{5-x}{9}$	M2	M1 for $\frac{x}{10} \times \frac{x-1}{9}$ or $\frac{6-x}{10} \times \frac{5-x}{9}$
	$30 - 5x - 6x + x^2$ or better	B1	
	$\frac{12 + x^2 - x + 30 - 11x + x^2}{90}$ oe leading to $\frac{x^2 - 6x + 21}{45}$	A1	
9(c)(ii)	$\frac{x^2 + 6x + 21}{45} = \frac{16}{45}$ or better, leading to $x^2 - 6x + 5 = 0$ with no errors	1	
9(c)(iii)	5 and 1	2	M1 for $(x-5)(x-1) [=0]$ or $[x =] \frac{- -6 \sqrt{(-6)^2 - 4 \times 1 \times 5}}{2 \times 1}$ oe
9(c)(iv)	$\frac{5}{10}$ oe	2	B1 for white = 1 or blue = 5

Question	Answer	Marks	Partial Marks
10(a)	$[\cos] = \frac{600^2 + 800^2 - 750^2}{2 \times 600 \times 800}$	M2	M1 for $750^2 = 600^2 + 800^2 - 2 \times 600 \times 800 \times \cos C$
	62.88 to 62.89	A1	
10(b)	403 or 403.3 to 403.5	4	M3 for $\frac{375000 - \frac{1}{2} \times 800 \times 600 \times \sin 62.9}{\frac{1}{2} \times 800}$ oe or B2 for 214 000 or 213 600 to 213 700 or M1 for $\frac{1}{2} \times 800 \times 600 \times \sin 62.9$ or $\frac{1}{2} \times 800 \times AD = 375000 - \text{their } 214000$ oe
10(c)	26.7 or 26.8 or 26.73 to 26.76	2	M1 for $\tan C = \frac{\text{their}(b)}{800}$
10(d)	133.8 to 134.0...	4	B3 for answer 45.96... to 46.17... or M2 for $\frac{800 \sin \text{their}(c)}{500}$ or $\frac{500 \sin(90 - \text{their}(c))}{\text{their } 403}$ or M1 for $\frac{800}{\sin X} = \frac{500}{\sin \text{their}(c)}$ or $\frac{\text{their } 403}{\sin X} = \frac{500}{\sin(90 - \text{their}(c))}$



Cambridge O Level

MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2020

MARK SCHEME

Maximum Mark: 100

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

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This document consists of **8** printed pages.

Generic Marking Principles

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GENERIC MARKING PRINCIPLE 1:

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- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

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GENERIC MARKING PRINCIPLE 3:

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- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Mathematics Specific Marking Principles	
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2	Unless specified in the question, answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected.
3	Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points.
4	Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).
5	Where a candidate has misread a number in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 mark for the misread.
6	Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

Abbreviations

cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
nfww	not from wrong working
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)	6	2	M1 for $\frac{22790 - 21500}{21500} [\times 100]$ oe or $\frac{22790}{21500} \times 100$ oe
1(b)	1354.5[0]	2	M1 for $[1260 +] \frac{3 \times 2.5}{100} \times 1260$ oe
1(c)	63[.00] cao	2	M1 for $\frac{4300}{67.8}$ soi
2(a)	$w + 6 + w + w + 6 + w = 37$ oe	M2	M1 for length = $w + 6$
	6.25	B1	
2(b)	295.5	3	B1 for two of 28.5, 15.5, 19.5, 7.5 M1 for <i>their</i> $(28.5 \times 15.5) - (19.5 \times 7.5)$
3(a)	33.7 or 33.69...	2	M1 for $\tan = \frac{8}{12}$ oe
3(b)	8.51 or 8.513...	2	M1 for $\sin 70 = \frac{8}{QL}$ oe
3(c)	1.3	2	M1 for $\frac{1.6}{TS} = \frac{8}{6.5}$ oe
4(a)(i)	15	1	
4(a)(ii)	Correct histogram	3	B1 for three or more rectangles on correct base B1 for three or more correct frequency densities soi

Question	Answer	Marks	Partial Marks
4(b)(i)	4.32 oe	3	M2 for $\frac{1 \times 8 + 3 \times 16 + 5 \times 15 + 7 \times 7 + 9 \times 4}{8 + 16 + 15 + 7 + 4}$ or M1 for $1 \times 8 + 3 \times 16 + 5 \times 15 + 7 \times 7 + 9 \times 4$ or $\frac{\sum fc}{8 + 16 + 15 + 7 + 4}$
4(b)(ii)	Correct cumulative frequency curve	3	B2 for four or five correct points plotted or B1 for correct cumulative frequencies soi
4(b)(iii)	4 to 4.2	1	
5(a)	Correct method to eliminate one variable	M2	M1 for attempt to equate coefficients or attempt to make x or y the subject of one equation
	$x = 0.5$ oe, $y = -2.5$ oe	A2	A1 for either $x = 0.5$ oe or $y = -2.5$ oe After A0, SC1 for a pair of values that satisfy either equation or for correct answers with no working
5(b)	$2x^2 + 3x - 24 = 0$ oe	B1	
	$\frac{-3 \pm \sqrt{3^2 - 4 \times 2 \times -24}}{2 \times 2}$	B2	FT <i>their</i> 3-term quadratic B1FT for $\sqrt{3^2 - 4 \times 2 \times -24}$ or for $\frac{-3 \pm \sqrt{p}}{2 \times 2}$
	2.79, -4.29	B1	
5(c)(i)	$\frac{36}{g^3}$	2	M1 for $h = \frac{k}{g^3}$ oe or $[k =] 4.5 \times 2^3$
5(c)(ii)	1.5 oe	2	M1 for $g^3 = \frac{\text{their } 36 \times 3}{32}$ oe
6(a)(i)	0.2 or $\frac{1}{5}$ oe	1	
6(a)(ii)	23, 43, 53	2	B1 for three correct and one incorrect or for two correct and none incorrect
6(a)(iii)	0.3 or $\frac{6}{20}$ oe	2	B1 for $\frac{6}{k}$ where k is an integer > 6 or for 24, 32, 36, 52, 56 and 64 identified
6(b)(i)	35, 22, 38	1	

Question	Answer	Marks	Partial Marks
6(b)(ii)	$\frac{77}{200}$ or 0.385	2	B1 for $\frac{46+31}{k}$ where k is an integer > 77 or SC1 for $\frac{105}{200}$ or 0.525
6(b)(iii)	Large sample	B1	
	$\frac{46}{200}$ is a lot bigger than $\frac{1}{6}$ oe or $\frac{22}{200}$ is a lot smaller than $\frac{1}{6}$ oe	B1	
7(a)(i)	1, 2	1	
7(a)(ii)	Correct curve	3	B2FT for 6 or 7 points correctly plotted or B1FT for 4 or 5 points correctly plotted
7(a)(iii)	Tangent drawn at (2, 16)	B1	
	18 to 27	B1	Dependent on correct tangent or close attempt
7(a)(iv)(a)	$a = -60, b = 36$	2	B1 for either correct or $3(4^x) - 60x + 36 [= 0]$
7(a)(iv)(b)	$y = 20x - 12$ ruled line	M2	M1 for one correct coordinate soi
	0.7 to 0.8, 2.65 to 2.75	B1	
7(b)	$p = 1$	B1	
	$q = 9$	B2	M1 for $[y =] (4 - x)(x + 2)$ oe or $[y =] q - (x - 1)^2$ oe or two correct equations in x and y using (-2, 0), (4, 0) or (0, 8) or SC1 for $q = -9$
8(a)	376.99 to 377.04	2	M1 for $\pi \times 10^2 \times \text{figs } 12$
8(b)	767 or 766.5 to 766.6...	3	M2 for $\pi \times 10^2 + \pi \times 2 \times 10 \times (3 + 3 + \text{figs } 12)$ or M1 for $\pi \times 10^2$ or $\pi \times 2 \times 10 \times (3 + 3 + \text{figs } 12)$
8(c)	28.79 to 28.80...	3	M2 for $200 = \frac{x}{360} \times \pi \times 10.3^2 \times 7.5$ or M1 for $\frac{x}{360} \times k\pi$ used

Question	Answer	Marks	Partial Marks
9(a)	63	B1	
	$\hat{MLN} = 54$ angles on a straight line or $\hat{LMN} + \hat{MNL} = 126$ exterior angle of a triangle	B1	
	$\hat{MNL} = 63$ or $\hat{NML} = 63$ angles in isosceles (triangle)	B1	
	$\hat{MNL} = \hat{FMN}$ alternate angles or $\hat{GLM} = \hat{LMF}$ alternate angles or $\hat{EML} = 54$ co-interior with $\hat{GLM}$ (or alternate with $\hat{MLN}$) and angles on a straight line	B1	
9(b)(i)	$\frac{y}{2}$ oe	1	
9(b)(ii)	x	1	
9(b)(iii)	$90 + x$ oe	2	FT $90 + \text{their (a)(ii)}$ B1 for $\hat{BAC} = 90^\circ$ or $\hat{BDC} = 90^\circ$
9(b)(iv)	$90 - x - \frac{y}{2}$ oe	1	
10(a)	$FC^2 = \left(\frac{10}{2}\right)^2 + \left(\frac{6}{2}\right)^2$ oe or $EX^2 = 12^2 - \left(\frac{6}{2}\right)^2$ or $EY^2 = 12^2 - \left(\frac{10}{2}\right)^2$	M2	M1 for $AC^2 = 10^2 + 6^2$ oe or $EX^2 + \left(\frac{6}{2}\right)^2 = 12^2$ or $EY^2 + \left(\frac{10}{2}\right)^2 = 12^2$
	$[EF^2 =] 12^2 - \text{their } FC^2$ oe or $[EF^2 =] \text{their } EX^2 - \left(\frac{10}{2}\right)^2$ or $[EF^2 =] \text{their } EY^2 - \left(\frac{6}{2}\right)^2$	M1	Dep on M2
	10.49 or 10.488...	A1	
10(b)	210 or 209.7 to 209.8	2	M1 for $\frac{1}{3} \times 6 \times 10 \times 10.5$

Question	Answer	Marks	Partial Marks
10(c)	29.0 or 28.95 to 28.96	3	M2 for $[\cos =] \frac{12^2 + 12^2 - 6^2}{2 \times 12 \times 12}$ or $2\sin^{-1}\left(\frac{3}{12}\right)$ or M1 for $6^2 = 12^2 + 12^2 -$ $2 \times 12 \times 12 \cos E$ or $\sin = \frac{3}{12}$
10(d)	34.9 or 34.85 to 34.86	2	FT $72\sin(\text{their (c)})$ M1 for $\frac{1}{2} \times 12 \times 12 \times \sin(\text{their } 29.0)$ or $\frac{1}{2}\sqrt{12^2 - 3^2} \times 6$ oe
11(a)	Reflection $y = -1$	2	B1 for either
11(b)	$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$	2	B1 for one correct row or column or Rotation, 90° anticlockwise about (0, 0)
11(c)	Triangle with vertices (-1, -2) (0, -2) (0, -5)	3	B2 for triangle with correct orientation but wrong position or B1 for triangle reflected in $x = 2$ After 0, SC1 for triangle with vertices (-3, -2) (-4, -2) (-4, 1)